Artificial Reefing

Ex-ORISKANY Artificial Reef Project Ecological Risk Assessment

June 2005 (Draft Final)

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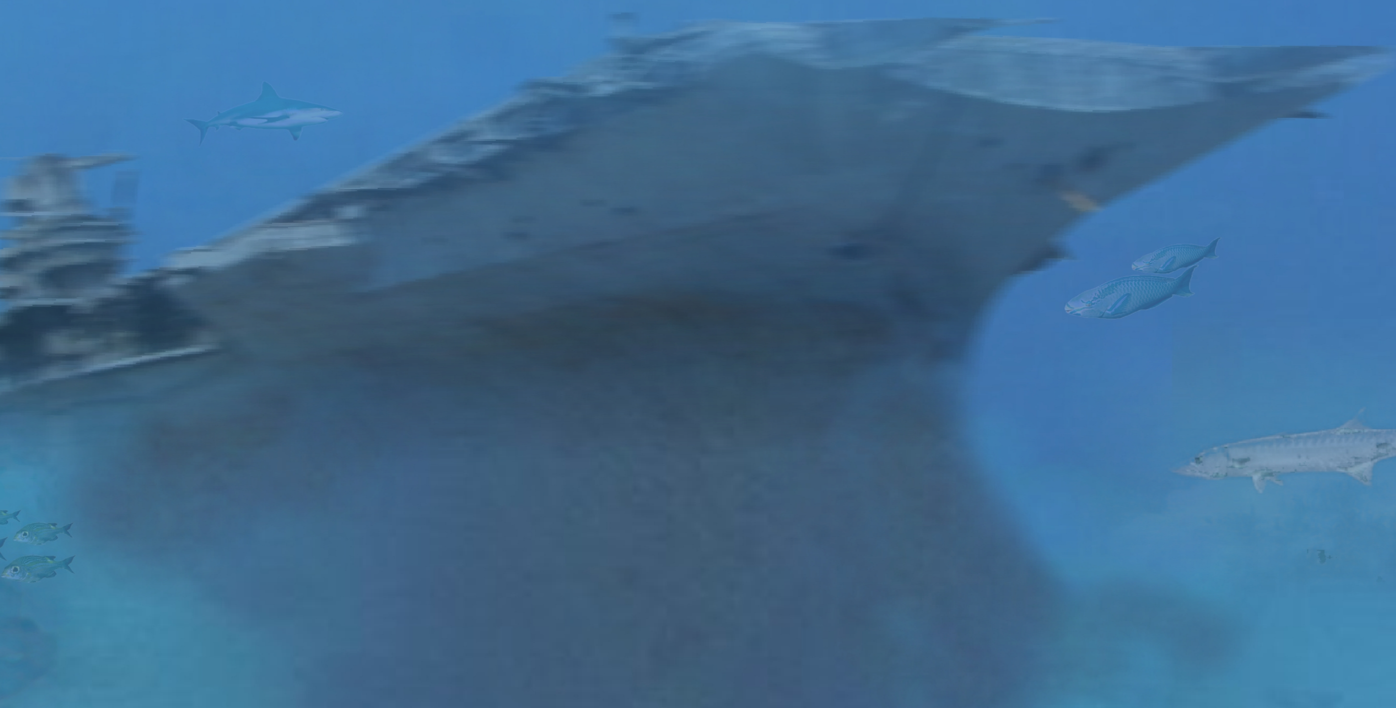

PROGRAM EXECUTIVE OFFICE SHIPS

Space and Naval Warfare Systems Center
Advanced Systems and Applied Sciences Division
Environmental Sciences and Applied Systems Branch
Code 2375, 53475 Strothe Rd.
San Diego, CA 92152-6326 USA

EX-ORISKANY ARTIFICIAL REEF PROJECT:

ECOLOGICAL RISK ASSESSMENT

Draft Final Report

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Prepared By:
R.K. Johnston, R. George,
K.E. Richter, P.F. Wang, and W.J. Wild
Marine Environmental Support Office
Environmental Sciences and Applied Systems Branch
Space and Naval Warfare Systems Center Code 2375
San Diego, CA 92152-6326

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This report is dedicated to the memory of Mark S. Goodrich, *modeler extraordinaire* (April 25, 1957 – January 7, 2005).

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Photo by Keith Mille (keith.mille@MyFWC.com)
Florida Fish & Wildlife Conservation Commission

Glossary of Terms, Acronyms, and Abbreviations

Term	*Definition*
Accuracy	The degree of agreement between a measured value and a true, expected value.
Acute Toxicity	The ability of a substance to cause effects resulting in severe biological harm within a short time after exposure to the toxic compound, usually within 24 to 96 hours.
ADL	Arthur D. Little, Cambridge, MA
Ag	Silver
Al	Aluminum
Alkylated	An organic compound with an **alkyl** group attached
Alkyl	A hydrocarbon consisting of *n* carbons and *2n+1* hydrogen molecules (C_nH_{2n+1})
Algae	Microscopic plants which contain chlorophyll and live floating or suspended in water as **phytoplankton** in the **plankton**. They also may be attached to structures, rocks or other submerged surfaces. They are food for fish and small aquatic animals. **Algae** produce oxygen during sunlight hours and use oxygen during the night hours.
Ambient	Environmental or natural surrounding conditions.
ANOVA	Analysis of variance
ANTH	Anthracene - one of a number of **PAH** compounds.
Anthropogenic	Something made by humans, which effects nature.
As	Arsenic
Assessment Endpoint	A component of the ecosystem that may be impacted by the stressors of concern, has ecological and societal value, and represents a component of the ecosystem that can be protected.
Avian Consumers	Birds of prey and waterfowl (ducks, geese, gulls, cormorants, and ospreys), which feed on prey from marine and estuarine waters.
AVS	Acid Volatile Sulfides - A reactive pool of sulfides that will bind with **divalent heavy metals** to form nontoxic and nonmobile compounds. These sulfides are released when sediments are treated with acid and the amount of sulfide released is referred to as **AVS** and the amount of metals that are simultaneously released is referred to as simultaneously extracted metal (**SEM)**.
AXYS	AXYS Analytical Services, Ltd., Sidney, British Columbia, Canada
Background Level	Naturally occurring levels, **ambient** concentrations.
BAF	bioaccumulation factor, "the ratio (in L/kg) of a substance's concentration in tissue of an aquatic organism to its concentration in the ambient water" (U.S. EPA 1995). BAFs are used to account for the trophic transfer of a contaminant in the food chain
B_{CV}	The bioaccumulation critical value is the tissue concentration in an organism that when exceeded suggests that ambient water quality criteria were exceeded.
Benchmark	A specific chemical concentration (in sediment, water, or tissue) or biological response when exceeded has been associated with adverse effects.
Benthic Community	Community of organisms, which spends the majority of their life living within the bottom **sediments** (worm, clam, amphipod, etc.).

Bioaccumulation	The **uptake** and retention of substances by an organism from its food and its surrounding environment. Chemicals that bioaccumulate become more concentrated at each successively higher level of the food chain. Bioaccumulative chemicals can be toxic to organisms at the upper end of a food chain, such as predatory fish, loons, eagles, otters, or humans that eat fish.
Bioassay	Study to measure the effects of a chemical on a living organism.
Bioconcentration	A specific **bioaccumulation** process by which the concentration of a chemical in an organism becomes higher than its concentration in the air or water around the organism.
Biomagnification	A process that results in the **bioaccumulation** of a chemical in an organism at higher levels than are found in its food. It occurs when a chemical becomes more and more concentrated as it moves up through a **food chain**. At the top of the food chain an animal, through its regular diet, may accumulate a much greater concentration of chemical than was present in organism lower in the food chain.
Biota	Animal and plant life.
Bulk Sediment	The total **sediment** concentration (of a chemical) analyzed on a dry weight basis.
Carnivorous	Animals that subsist by feeding on flesh of prey (other animals)
Calibration	A procedure that checks or adjusts an instrument's accuracy by comparison with a standard or reference.
CBR	The concentration of a contaminant in the tissue of an organism that can cause adverse effects to the organism when exceeded.
CCC	Criteria Continuous Concentration (CCC – chronic), an estimate of the highest concentration of a material in the water column to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect
CCME	Candaian Council of Ministers of the Environment
Cd	Cadmium
Chlorophyll	One of a number of green pigments present in plant cells that are essential in the utilization of light energy in photosynthesis.
Chronic Toxicity	The ability of a substance to cause poisonous effects from long-term exposure, usually months or years.
CMC	Criterion maximum concentration (CMC – acute) an estimate of the highest concentration of a material in the water column to which an aquatic community can be exposed briefly without resulting in an unacceptable effect
COC	Contaminants of Concern - chemicals identified as having the potential to cause ecological impacts.
Coliform	A group of bacteria found in the intestines of warm-blooded animals (including humans) also in plants, soil, air and water. Fecal coliforms are a specific class of bacteria, which only inhabit the intestines of warm-blooded animals. The presence of coliform is an indication that the water is polluted and may contain pathogenic organisms.
Colloids	Very small, finely divided solids (particles that do not dissolve) that remain dispersed in a liquid for a long time due to their small size and electrical charge. When most of the particles in water have a negative electrical charge, they tend to repel each other. This repulsion prevents the particles from clumping together, becoming heavier, and settling out.
Conceptual Model	Theoretical representation of a situation.

Congener	Something closely resembling or analogous to something else, see **PCB congener**
Cr	Chromium
Cu	Copper
$D_{BlackDuck}$	The dietary concentration for the consumption of fish and invertebrates by black ducks that is unlikely to be harmful to black ducks.
$D_{Dolphin}$	The dietary concentration for the consumption of fish and invertebrates by dolphins that is unlikely to be harmful to dolphins.
Divalent	A chemical that can exist as an ion with a charge of 2^+ (e.g. Cd^{2+}, Cu^{2+}, Pb^{2+}, etc.).
Dose-Response	A quantitative relationship between the dose of a chemical and an effect caused by the chemical.
Dose-Response Curve	A graphical presentation of the relationship between degree of **exposure** to a chemical (dose) and observed biological effect or response.
D_{Osprey}	The dietary concentration for the consumption of fish by osprey that is unlikely to be harmful to osprey.
EC_{20}	Effect Concentration 20% **-** the concentration of a chemical in air or water which is expected to cause an effect (other than death, e.g. reproductive impairment, reduced growth, biochemical response etc.) in 20% of test animals living in that air or water.
Ecological Receptors	Representative species selected to evaluate the likelihood of adverse impact to the **Assessment Endpoint**.
Ecosystem	An ecological system, a natural unit of living and nonliving components, which interact to form a stable system in which a cyclic interchange of materials takes place between living, and nonliving units.
Eelgrass	A **submerged aquatic plant** (*Zostera marina*) which can form meadows (eelgrass beds) that are capable of trapping sediment and providing habitat for a variety of birds, fish, and invertebrates.
EELAARS	Escambia East Large Area Artificial Reef Site is an area permitted by the Army Corps of Engineers for the creation of artificial reefs, it is located about 22.5 mi from Pensacola, FL (see Figure 2).
Effects Assessment	The determination or estimation (qualitative or quantitative) of the magnitude, frequency, duration and extent of effects from exposure to a chemical.
Effects Measure	See **Measures of Effects.**
Effluent	Wastewater, treated or untreated, that flows out of a treatment plant, sewer, or industrial outfall into surface water.
Environmental Media	Components of the environment (water, **sediment**, and **biota**) that can accumulate contaminants.
Environmental Release	The introduction of a pollutant into the environment through wastewater discharge, air emission, or volatilization or leaching from soil, landfill, or other contaminated site.
EOD	Explosive Ordnance Disposal
Epibenthic Species	The community of organisms (e.g. lobster, mussel) which spend the majority of their life attached to or in close proximity to the bottom of .a body of water.
Equilibrium Partitioning	The partitioning or distribution of an **organic** contaminant between **bulk** and **pore water** phases of the **sediment**.
EMAP	Environmental Monitoring and Assessment Program
ERL	Effects Range - Low - the concentrations of contaminants below which adverse biological effects would rarely occur

would rarely occur.

ERM Effects Range - Median - concentrations of contaminants above which adverse biological effects would probably occur.

Exposure Contact with or ingestion of a chemical or physical agent.

Exposure Assessment The determination or estimation (qualitative or quantitative) of the magnitude, frequency, duration, route, and extent of **exposure** to a chemical.

Exposure Level The amount (concentration) of a chemical that comes into contact with an organism through the air, water, sediment, or food.

Exposure Scenario A set of conditions or assumptions about sources, exposure pathways, concentrations of toxic chemicals and populations (numbers, characteristics and habits), which aid in evaluating and quantifying exposure.

FDEP Florida Department of Environmental Protection

Fe Iron

FLUOR Fluorene - one of a number of **PAH** compounds.

FFWCC Florida Fish and Wildlife Conservation Commission

Fluorescence The property of absorbing light of a particular wave length and then emitting light of a different color and wave length.

Food Chain A sequence of organisms, each of which uses the next lower member of the sequence as a food source.

GC/MS SIM An analytical chemistry method requiring gas chromatography, mass spectroscopy, and selective ion monitoring

GLWQI-Wildlife Great Lakes Water Quality Initiative criteria for protection of wildlife

Heavy Metal Any metal with a density of 5.0 or greater, especially one that is toxic to organisms, as **lead**, **mercury**, **copper**, and **cadmium**.

Hg Mercury

Inorganic Composed of matter other than plant or animal.

LC_{50} Lethal Concentration 50% - the concentration of a chemical in air or water which is expected to cause death in 50% of test animals living in that air or water.

LD Lethal Dose - the amount of a toxic substance required to cause death of an organism under study in a given period of time

LD_{50} Lethal Dose 50% - the dosage of a toxic substance required to kill one half of the organisms under study in a given period of time

LKA Landing amphibious cargo ship

LOAEL Lowest Observed Adverse Effect Level - the lowest dose in an experiment, which produced an observable adverse effect.

LOED Lowest Observed Effects Dose – the lowest dose in an experiment which produced an observable effect. The dose can refer to the concentration of chemical in the diet or the concentration of the chemical in tissues of the organism.

MARAD U.S. Maritime Administration

Measures of Effects Measurements that provide information about effect, impact, or stress on **Ecological Receptors**.

Measures of Exposure	Measurements that quantify the concentration of **COCs** in sediment, water, or biota.
Metal	Any of a class of elementary substances, as gold, **silver**, or **copper**, all of which are crystalline when solid, and many of which are characterized by opacity, ductility, conductivity, and a unique luster when freshly fractured. Metals will yield positively charged ions in aqueous solution of its salts.
Methylated	An organic compound with an **methyl** group attached
Methyl	A hydrocarbon containing one carbon and three hydrogen molecules CH_3
Methylmercury	Any of several toxic compounds formed from metallic mercury by the action of microorganisms and capable of **bioaccumulating** in the **food chain**.
Mg	Milligram - one-thousandth of a gram (0.000035 oz.).)
mg/L	Milligrams Per Liter - a measure of concentration of a dissolved substance. A concentration of one mg/L means that one milligram of a substance is dissolved in each liter of water which is equal to **parts per million** (**ppm**) since one liter of water is equal in weight to one million milligrams. For example: a liter of water containing 10 milligrams of calcium has 10 parts of calcium per one million parts of water, or 10 parts per million (10 ppm).
Mn	Manganese
Molecular Weight	The molecular weight of a compound in grams is the sum of the atomic weights of the elements in the compound.
Mortality	The proportion of deaths to population.
NEHC	Navy Environmental Health Center, Norfolk, VA
Ni	Nickel
NOAEL	No Observed Adverse Effect Level - the highest dose in an experiment which did not produce an observable adverse effect.
NOED	No Observed Effects Dose – the highest dose in an experiment which did not produce an observable effect. The dose can refer to the concentration of chemical in the diet or the concentration of the chemical in tissues of the organism.
NOEL	No Observed Effect Level - in concentration response experiments, the concentration level at which no effects are noted.
Non-Point Source Pollution	Diffuse **pollution** sources that do not have a single point of origin or are not introduced into **receiving waters** from a specific outlet. The pollutants are generally carried off the land by storm water runoff. The commonly used categories for non-point sources are agriculture, forestry, urban, mining, construction, dams and channels, land disposal, and saltwater intrusion.
Organic	Composed of plant or animal matter.
PAH	Polycyclic Aromatic Hydrocarbons - compounds containing more than one benzene ring in its structure.
Particulate	Very small solid particles suspended in water which can vary widely in size, shape, density, and electrical charge. **Colloidal** and dispersed particulates are artificially gathered together by the processes of coagulation and flocculation.
Partition Coefficient	A measure of the extent to which a chemical is divided between the soil/sediment and water phases.
Pb	Lead

PCB — Polychlorinated Biphenyl - any of several compounds that are produced by replacing hydrogen atoms in biphenyl with chlorine. Used in various industrial applications, they tend to accumulate in animal tissues. PCB (or PCBs) is a category, or family, of chemical compounds formed by the addition of Chlorine (Cl_2) to Biphenyl ($C_{12}H_{10}$), which is a dual-ring structure comprising two 6-carbon Benzene rings linked by a single carbon-carbon bond. For more information see: http://www.epa.gov/toxteam/pcbid/defs.htm

PCB congener — A group of 209 individual PCB compounds having from 1 to 10 chlorine atoms attached to biphenyl rings. The name of a congener specifies the total number of chlorine substituents and the position of each chlorine. For example: 4,4'-Dichlorobiphenyl is a congener comprising the Biphenyl structure with two chlorine substituents, one on each of the two carbons at the "4" (also called "para") positions of the two rings. For more information see: http://www.epa.gov/toxteam/pcbid/defs.htm

PCB homologs — "Homologs" are subcategories of **PCB congeners** having equal numbers of chlorine substituents. For example, the "Tetrachlorobiphenyls" (or "Tetra-PCBs" or "Tetra-CBs" or just "Tetras") are all PCB congeners with exactly 4 chlorine substituents that may be in any arrangement. For more information see: http://www.epa.gov/toxteam/pcbid/defs.htm

Pelagic Species — The community of organisms (fish, **plankton**), which spend the majority of their life floating or swimming in the water.

PHEN — Phenanthrene - One of a number of **PAH** compounds

Phytoplankton — Microscopic plants (such as **algae**), that forms the basis of the **food chain** in oceans, estuaries, rivers, lakes, and other bodies of water.

Plankton — Aquatic organisms of fresh, brackish, or sea water which float passively or exhibit limited locomotor activity (e.g. **algae**, **phytoplankton**, **zooplankton**).

Point Source — A stationery location or fixed facility from which pollutants are discharged or emitted. Also, any single identifiable source of pollution, (e.g., a pipe, ditch, ship, ore pit, factory smokestack).

Pollutant — Any substance introduced into the environment that adversely affects the usefulness of a resource.

Pore Water — The spaces between sediment particles that are saturated with water.

ppb — Parts Per Billion - a measurement of concentration on a weight or volume basis. One ppb equals one unit of measurement per billion units of the same measurement. One ppb equals one microgram per liter (**μg/L**) for volume or one nanogram per gram (**ng/g**) or alternatively one microgram per kilogram (**μg/Kg**) for weight.

ppm — Parts Per Million - a measurement of concentration on a weight or volume basis. One ppm equals one unit of measurement per million units of the same measurement. One ppm equals one milligram per liter (**mg/L**) for volume or one microgram per gram (**μg/g**) or alternatively one milligram per kilogram (**mg/Kg**) for weight.

Precision — The ability of an instrument to measure a process variable and to repeatedly obtain the same result.

PYRENE — One of a number of **PAH** compounds.

QA/QC — Quality Assurance/Quality Control

Receiving Waters — All distinct bodies of water that receive runoff or wastewater discharges, such as streams, rivers, ponds, lakes, estuaries, and oceans.

Receptor — Any organism or environmental media which is exposed to contamination from a discharge.

REEFEX	The creation of artificial reefs by sinking ex-Navy vessels.
Risk	A measure of the probability that damage to the environment will occur as a result of a given hazard.
Risk Assessment	A qualitative or quantitative evaluation of the environmental and/or health risk resulting from exposure to a chemical or physical agent (**pollutant**); combines **exposure assessment** results with **toxicity assessment** results to estimate risk.
Risk Characterization	Final component of **risk assessment** that involves integration of the data and analysis involved in the **exposure assessment** and the ecological **effects assessment** to determine the likelihood that ecological impacts have or will occur.
Risk Definition - High Risk	Evidence of large and persistent impacts with a high degree of correlation between exposure and effects. Probable impacts are suggested.
Risk Definition - Intermediate Risk	Evidence of localized impacts but weak correlation between exposure and effects measures. Potential impacts are suggested.
Risk Definition - Low Risk	Evidence of exposure and effects but no correlation between exposure and effects measures. Limited impacts are suggested.
Risk Definition - Negligible Risk	Very little evidence of exposure and effects. No impacts ar suggested.
Risk Drivers	Chemicals or processes that may be responsible for causing elevated risk.
Risk Management	The process for evaluating and selecting responses to risk.
S_B	**Benchmark** concentration in **sediment** that is protective of marine organisms.
SCDNR	South Carolina Department of Natural Resoucres
Sediment	Matter which settles to the bottom in oceans, estuaries, rivers, lakes or other waterbodies.
SEM	Simultaneously Extracted Metal - the **heavy metals** associated with the reactive pool of **acid volatile sulfides**. The sulfides are released when sediments treated with acid and the amount of sulfide released is referred to as **AVS** and the amount of metals that are released simultaneously is referred to as **SEM**.
SINKEX	The sinking of ex-Navy vessels as part of weapons testing operations.
SSD	Species sensitivity distributions are cumulative distribution functions, that describe the proportion of a class of organisms that are expected to be affected by a given level of exposure to a contaminant.
sumPCB	The sum of the measured **PCB congeners**.
Superfund	Federal law, which authorizes EPA to manage the clean up of abandoned or uncontrolled hazardous waste sites.
SWMU	Solid Waste Management Unit - an area designated in the Shipyard's Hazardous Waste Permit where hazardous materials may have been stored, treated, or released.
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin (most toxic from of dioxin)
tDDx	Total **DDT** and metabolites (sum of **DDT**, **DDE**, and **DDD**).
TEF	Dioxin Toxicity Equivalent Factor, **TEF** expresses the potency of PCB congeners relative to **TCDD** (i.e., TCDD TEF = 1)

TEQ	Toxicity equivalent quotient (**TEQ**). The TEQ is calculated by summing the products of the concentrations of individual congener [PCBcongener] and their toxicity equivalency factor (**TEF**): **TEQ** = Σ [PCBcongener]×TEF]
T_{Fish}	**Benchmark** concentrations in tissue residues of fish that when exceeded, has been associated with adverse effects.
Threshold	The lowest dose of a chemical at which a specified measurable effect is observed and below which it is not observed.
TL	Trophic Level, how high an organism is in the food chain
T_{Invert}	**Benchmark** concentrations for tissue residues of invertebrates that when exceeded, has been associated with adverse effects.
Toxic	A substance that is poisonous to an organism.
Toxic Pollutants	Materials contaminating the environment that cause death, disease. birth defects in organisms that ingest or absorb them. The quantities and length of exposure necessary to cause these effects can vary widely.
Toxic Substance	A chemical or mixture that may represent an unreasonable risk of injury to health or the environment.
Toxicant	A harmful substance or agent that may injure an exposed organism.
Toxicity	The quality or degree of being poisonous or harmful to plant, animal or human life.
Toxicity Assessment	Characterization of the toxicological properties and effects of a chemical, including all aspects of its absorption, metabolism, excretion and mechanism of action, with special emphasis on establishment of dose- response characteristics.
Toxicology	The science and study of poisons control.
tPCB	Total **PCB**, usually determined by the sum of the **PCB homologs**.
Trophic Transfer	The process by which contaminants are accumulated in the **food chain**.
TSV	Tissue screening values are tissue residue of chemicals, below which it is unlikely that adverse effects will occur.
Turbidity	A measure of water cloudiness caused by suspended solids
μg	Microgram - one-millionth of a gram (0.000000035 oz.).)
μg/L	Micrograms Per Liter - one microgram of a substance dissolved in each liter of water. This unit is equal to **parts per billion** (**ppb**) since one liter of water is equal in weight to one billion micrograms.
Uptake	The entrance of a chemical into an organism — such as by breathing, swallowing, or absorbing it through the skin — without regard to its subsequent storage, metabolism, and excretion by that organism.
VOC	Volatile Organic Compound - a photochemically reactive organic compound which evaporates readily under normal temperature and pressure conditions. VOCs are contributors to the formation of ground level ozone.
Volatile	Readily vaporizable at a relatively low temperature.
Water Quality Criteria	The concentration of a constituent in water below which is not considered harmful to aquatic life
Watershed	The land area that drains into a stream. An area of land that contributes runoff to one specific delivery point; large watersheds may be composed of several smaller "subsheds", each of which

	contributes runoff to different locations that ultimately combine at a common delivery point.
W_B	Water benchmark concentration, usually set to **water quality criteria**
WV_{Fish}	Wildlife protection value derived to be protective of piscivorous birds and mammals (U.S. EPA 1997).
Wetlands	Any number of tidal and nontidal areas characterized by saturated or nearly saturated soils most of the year that form an interface between terrestrial (land-based) and aquatic environments; include freshwater marshes around ponds and channels (rivers and streams), brackish and salt marshes; other common names include swamps and bogs.
Zn	Zinc.
Zooplankton	Animal life of the **plankton**.

Photo by Keith Mille (keith.mille@MyFWC.com)
Florida Fish & Wildlife Conservation Commission

1. Executive Summary

1.1 Objective and Purpose

The purpose of this report is to assess the ecological risks associated with sinking the aircraft carrier ex-ORISKANY (CVA-34, Figure 1) to create an artificial reef off the coast of Pensacola, FL (Figure 2) within the Escambia East Large Area Artificial Reef Site (Figure 3). Because the ex-ORISKANY contains solid materials such as electrical cabling, gaskets, rubber products, and paints that contain concentrations of polychlorinated biphenyls (PCBs) ≥ 50 ppm, the vessel is regulated as PCB Bulk Product Waste under 40 CFR 761.62(c) and a risk-based disposal permit is required prior to sinking the vessel.

1.2 Technical Approach

In order to assess future risks from sinking the ex-ORISKANY, a prospective risk assessment model (PRAM, NEHC/SSC-SD 2005a) and a time dynamic model (TDM, NEHC/SSC-SD 2005b) were developed to model the release, fate, transport, and bioaccumulation of PCBs leached from solid materials contained onboard the vessel. Using empirical leach rate data, developed from laboratory studies of PCB releases from shipboard solids under shallow water artificial reef conditions (George et al. 2005), PRAM simulates the steady state concentrations of PCBs in the water and sediment around the reef and the bioaccumulation of PCBs within the food chain of the reef (NEHC/SSC-SD 2005a). The TDM simulates the abiotic accumulation from the release of PCBs from the ship for a two-year period from the time of sinking until the reef is fully developed and near steady-state conditions at the reef are achieved (NEHC/SSC-SD 2005b). This ecorisk assessment evaluates the results of the models to characterize potential toxicological risks from PCBs to ecological receptors that could reside, feed, and/or forage at the artificial reef.

The PRAM and TMD models were specifically developed to model PCB releases from the ship and accumulation of PCBs in the abiotic and food chain of the pelagic, benthic, and reef communities (Figure 10). The assessment endpoints were developed to assess the potential effects to survival, growth, and reproduction to the communities and organisms modeled by PRAM as well as ecological consumers that could also feed and forage at the reef. The assessment endpoints modeled by PRAM (Table 2) were concentrations of PCB homologs in water, sediment, primary producers (Trophic Level – TL=1, phytoplankton and encrusting algae), primary consumers (TL=2, copepod, bivalve, urchin, polychaete, and nematode), secondary consumers (TL=III, herring, triggerfish, lobster, and crab), and tertiary consumers (TL=IV, jack, grouper, and flounder). By grouping organisms according to their habitat and diet preferences, PRAM also provided data to evaluate the pelagic, benthic and reef communities (Table 2). Additional endpoints for other ecological consumers included avian consumers (cormorant and herring gull), sea turtles (loggerhead turtle), dolphins (bottlenose dolphin), and sharks (sandbar shark and great barracuda, Table 3, Figure 10).

The receptor species were evaluated to assess PCB exposure to species that comprise the reef community. This risk assessment only evaluated potential toxicological effects of exposure to PCBs and does not address the presence and physical structure of the artificial reef, which greatly influences the ecological processes present at site.

1.3 Vessel Preparation

In preparation for use as an underwater reef the ex-ORISKANY underwent an extensive cleanup program in accordance with the draft Best Management Practices for Preparing Vessels Intended to Create Artificial Reefs (US EPA and MARAD 2004). Vessel preparation involved removal of fuels, oils, loose asbestos containing material, capacitors, transformers or other liquid polychlorinated biphenyl (PCB) components, batteries, HALON, mercury, antifreeze, coolants, fire extinguishing agents, black and gray water, and chromated ballast water (NAVSEA 2004b, Figure 7). Due to the presence of PCBs found in the wooden flight deck and underlayment, much of flight deck and underlayment was removed and disposed of (Figure 8). Prior to vessel preparation the amount of PCBs contained within solid materials onboard the vessel were estimated to range from 377.5 Kg to 699.6 Kg (832.2 to 1542.3 lbs, average to 95% upper confidence level – UCL, Table 4, Pape 2004). Following the removal of 100% of the lubricants, 72.6% of the bulkhead insulation, 10% of the cabling, and 5% of the paints the total amount of PCBs remaining in solid materials onboard the vessel ranged from 327.79 to 608.85 Kg (722.7 to 1342.3 lbs, average to 95% UCL). More than 97% of the PCBs remaining on the vessel are associated with electrical cabling.

1.4 Model Evaluation

The output from the TDM and PRAM models were evaluated to the extent possible to identify any biases and verify the reliability of the results. Because the models are simulating future conditions, no field data are readily available to validate the model output. However model performance was evaluated to assure that the model results were internally consistent, that the predictions of the model conformed with the physiochemical properties being modeled, and that results produced by the model were consistent with similar studies reported in the literature. The model evaluation showed that the results from PRAM are plausible and reasonably good estimates of what would occur given that the other model assumptions and procedures are also accurate.

1.5 Risk Characterization

Output from the TDM and PRAM models were used to evaluate ecological risks to the reef community and other ecological consumers that may feed and forage on the reef. Short-term ecological risks (0 –2 years) were evaluated using the data obtained from the TDM coupled to PRAM. The long-term ecorisk (steady state) was evaluated using the results of PRAM under steady state conditions. Hazard Quotients were calculated by dividing the predicted concentrations from the models by the appropriate ecorisk benchmark. HQs were calculated from the time dynamic and steady state model results and evaluated for both the conservative and less conservative benchmarks for each applicable exposure pathway and assessment endpoint (Table 21). The HQs used in the evaluation were the highest HQ obtained from the time dynamic (TDM) or steady state (PRAM) model simulation. Water quality criteria and sediment quality guidelines were used as benchmarks to evaluate risks from water and sediment exposure.

Tissue residue benchmarks were based on bioaccumulation critical values, tissue screening values, critical body residues, and dietary uptake benchmarks. These benchmarks (Table 6) are chemical residue thresholds at or below which adverse toxicological effects would not be expected. The conclusions were based on the evidence of potential ecological harm.

1.6 Summary of Findings

The outputs of the TDM-PRAM and PRAM models were used to evaluate PCB exposures to the pelagic, benthic, and reef communities as well as dolphins, sea birds, sea turtles, and shark/barracuda that may be attracted to feed and forage on the reef. Predicted sediment and water concentrations were well below ecorisk benchmarks for both short-term and long-term exposure. Tissue concentrations predicted for the pelagic and benthic community were below expected background PCB concentrations. The modeled concentrations in the upper trophic level of the reef community were within the range of background PCB values for the Gulf of Mexico. The PCB exposure levels predicted by the models were extremely to very unlikely of causing ecological effects because the concentrations of Total PCBs were well below the benchmarks of ecological effects.

Estimates of dioxin-like PCB (TEQ) exposure were obtained by assuming that dioxin-like coplanar congeners would be present in the same congener:homolog proportion observed in the leachrate experiments. Potential risks from dietary exposure of TEQs to gulls, cormorants and dolphins were evaluated by comparing modeled tissue concentrations in prey to TEQ dietary benchmarks for those species. Potential risks of TEQ exposure to fish eggs and sac-fry larvae, the most sensitive life stage of fishes to TEQ toxicity, were evaluated by predicting the maternal transfer of TEQs to fish eggs and comparing the resulting fish egg concentrations to sensitive egg residue benchmarks for TEQ exposure. It is extremely unlikely that the modeled TEQ exposure will cause an effect to dolphins, sea birds, or fish eggs and larvae because the modeled TEQ concentrations were well below the ecorisk benchmarks.

Based on the data available for evaluating tissue exposures to reef organisms, the risk of exposure from Total PCB in tissues of organisms associated with the reef and in the diet of reef consumers is negligible. Based on the data available for evaluating TEQ exposures to dolphin, birds, and fish eggs, the risk of exposure from TEQ in the diet of dolphins and birds and the maternal transfer of TEQ to fish eggs is negligible Table 27.

1.7 Uncertainty

Uncertainty in risk assessments arise from errors in assumptions, errors made during measurement activities, errors that occurred during analyses, and the natural variability in the components of the ecosystem that were studied. The major sources of uncertainty were the assumptions and parameters used in models, the applicability and sensitivity of the benchmarks used in the assessment, and uncertainty about the sources of PCBs on the vessel.

1.8 Conclusions

The criteria used to evaluate the model performance showed that the outputs from PRAM are plausible and reasonably good estimates of what would occur given that the other model assumptions and procedures are also accurate. Based on the data available for evaluating sediment, water, and tissue residue exposures to reef organisms, the risk of exposure from Total PCB and dioxin-like toxicity equivalents in tissues of organisms associated with the reef and in the diet of reef consumers is negligible. Therefore, it is unlikely that PCBs released from sinking the ex-ORISKANY to create an underwater reef will harm the environment.

Photo by Keith Mille (keith.mille@MyFWC.com)
Florida Fish & Wildlife Conservation Commission

2. Introduction and Purpose

The purpose of this report is to assess the ecological risks associated with sinking the aircraft carrier ex-ORISKANY (CVA-34, Figure 1) to create an artificial reef off the coast of Pensacola, FL (Figure 2) within the Escambia East Large Area Artificial Reef Site (Figure 3). Because the ex-ORISKANY contains solid materials such as electrical cabling, gaskets, rubber products, and paints that contain concentrations of polychlorinated biphenyls (PCBs) ≥ 50 ppm, the vessel is regulated as PCB Bulk Product Waste under 40 CFR 761.62(c) and a risk-based disposal permit is required prior to sinking[1]. Under the Toxic Substance Control Act (TSCA), a finding of no unreasonable risk of injury to human health and the environment must be made before EPA could allow disposal of PCB-contaminated material with concentrations ≥ 50 ppm. Since the assessment is a prospective risk assessment of future actions, the human health and ecorisk assessments use the results of a prospective risk assessment model (PRAM) developed specifically to model the potential release of PCBs from solid materials contained on ex-Navy vessels used to create artificial reefs (Goodrich et al. 2003, Goodrich 1994, NEHC/SSC-SD 2005a, b).

Previously, a multi-agency REEFEX Technical Working Group conducted retrospective human health (NEHC 2004) and ecorisk (Johnston et al. 2005) assessments using data from the ex-VERMILLION artificial reef, a former Navy troop-transport ship sunk off the coast of South Carolina in 1987. The REEFEX Technical Working Group consisted of representatives from the U.S. EPA, the U.S. Navy, the South Carolina Department of Natural Resources, Florida Fish and Wildlife Conservation Commission, Florida Department of Environmental Protection, Florida Department of Health, and Escambia County, FL. The technical approach and procedures used in this ecorisk assessment are based on the findings and recommendations for assessing ecological risks of sunken ships developed by the REEFEX Technical Working Group.

2.1 Objectives

The objective of this ecorisk assessment is to assess the potential toxicological risk of contaminants that may be released from the ex-ORISKANY during or after sinking to create an

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[1] "(c) Risk-based disposal approval. (1) Any person wishing to sample or dispose of PCB bulk product waste in a manner other than prescribed in paragraphs (a) or (b) of this section, or store PCB bulk product waste in a manner other than prescribed in Sec. 761.65, must apply in writing to: the EPA Regional Administrator in the Region where the sampling, disposal, or storage site is located, for sampling, disposal, or storage occurring in a single EPA Region; or the Director of the National Program Chemicals Division, for sampling, disposal, or storage occurring in more than one EPA Region. Each application must contain information indicating that, based on technical, environmental, or waste-specific characteristics or considerations, the proposed sampling, disposal, or storage methods or locations will not pose an unreasonable risk of injury to health or the environment. EPA may request other information that it believes necessary to evaluate the application. No person may conduct sampling, disposal, or storage activities under this paragraph prior to obtaining written approval by EPA. (2) EPA will issue a written decision on each application for a risk-based sampling, disposal, or storage method for PCB bulk product wastes. EPA will approve such an application if it finds that the method will not pose an unreasonable risk of injury to health or the environment". 40 CFR 761.62(c)

artificial reef. The risk assessment does not address the ecological consequences of creating the reef itself, it is focused on characterizing potential toxicological risks of PCBs that may be released from the ship.

This assessment addresses the following risk management question:

- *Is it likely that sinking the ex-ORISKANY, which contains solid materials bearing PCBs, will pose an unacceptable risk to the environment?*

2.2 Approach

In order to assess future risks from sinking the ex-ORISKANY, a prospective risk assessment model (PRAM, NEHC/SSC-SD 2005a) and a time dynamic model (TDM, NEHC/SSC-SD 2005b) were developed to model the release, fate, transport, and bioaccumulation of PCBs leached from solid materials contained onboard the vessel. Using empirical leach rate data, developed from laboratory studies of PCB releases from shipboard solids under shallow water artificial reef conditions (George et al. 2005), PRAM simulates the steady state concentrations of PCBs in the water and sediment around the reef and the bioaccumulation of PCBs within the food chain of the reef (NEHC/SSC-SD 2005a). The TDM simulates the abiotic accumulation from the release of PCBs from the ship for a two-year period from the time of sinking until the reef is fully developed and near steady-state conditions at the reef are achieved (NEHC/SSC-SD 2005b). This ecorisk assessment evaluates the results of the models to characterize potential toxicological risks from PCBs to ecological receptors that could reside, feed, and/or forage at the artificial reef. The results and conclusions from the ecorisk assessment will be used to support risk management decisions about the potential beneficial reuse of ex-ORISKANY as an artificial reef.

The empirical leach rate data showed that there was a time varying release of PCBs from most of the shipboard solids tested (George et al. 2005, Figure 4). The time varying release rates showed an initial “rinsing” or “wetting” behavior characterized by highly variable release rates (Region 1), followed by the maximum release rate (Region 2), and then, finally, a monotonically decreasing release rate that asymptotically approached steady state (Region 3, Figure 4). The PRAM model was designed to simulate the accumulation of PCBs resulting from the steady state release of PCBs into the environment (NEHC/SSC-SD 2005a). The TDM model was developed to augment PRAM by simulating changes of PCB levels in abiotic media during the initial time varying release period. The abiotic concentrations predicted by TDM were then input into a version of PRAM modified to simulate the accumulation of PCBs in the progressively developing food chain hypothesized to occur during the first two years following sinking (NEHC/SSC-SD 2005b). The output from the TDM and PRAM models were used to evaluate ecological risks to the reef community and other ecological consumers that may feed and forage on the reef. Short-term ecological risks (0 –2 years) were evaluated with the TDM coupled to PRAM. The long-term ecorisk (steady state) was evaluated using the results of PRAM under steady state conditions.

The results of the models were evaluated to the extent possible to assure that they provided reasonable, albeit conservative, estimates of PCB concentrations in the environment following sinking of the ex-ORISKANY. Because no data are currently available to validate the models, it is not possible to validate the model predictions with field data. Therefore the results and conclusions derived for this ecorisk assessment are based on the assumption that the modeled data are valid and representative of future conditions expected to occur at the artificial reef.

Photo by Keith Mille (keith.mille@MyFWC.com)
Florida Fish & Wildlife Conservation Commission

3. Background

3.1 Contaminant of Concern

Banned from manufacturing and distribution since 1978, polychlorinated biphenyls (PCBs) are highly bioaccumulative and the U.S. EPA has developed a strategy for protecting human health and the environment from exposure to PCBs and other persistent, bioaccumulative, and toxic (PBT) pollutants (U.S. EPA 1998a). Used extensively in the manufacturing of electrical capacitors, carbon-less copy paper, fire retardants, and other applications that required products with high heat resistance, elasticity, and durability, many PCBs have been improperly disposed resulting in an almost ubiquitous contamination of the environment. In the early 1990s it became clear that PCBs were also used in the manufacturing of wide assortment of solid materials that were used onboard U.S. Navy ships. These materials included electrical cables, rubber gaskets and hanger mounts, seals, insulating materials, foam rubber, and paints. Oils and greases were also found with high concentrations of PCBs present. It is impossible to know whether these materials were all manufactured with PCBs or if they became contaminated with PCBs during their life cycle or both.

The very properties that made PCBs so desirable for industrial applications are the same properties that cause PCBs to be resistant to degradation and to accumulate in the environment. PCBs are a mixture of compounds that consist of ten homologue groups (mono- through deca-biphenyl) and 209 different PCB congeners (See EPA Region V web site for PCB Species Identification, Barney 2001). PCBs were originally sold as Aroclor mixtures, or blends of PCB congeners manufactured to meet specified percentage levels of chlorination. In order to simulate the accumulation of PCBs in the environment, the PRAM and TMD were developed to modeled fate, transport and uptake of the ten PCB homologs in the environment. In the model, each homolog represents the contribution of all the congeners within that group and the amount of Total PCB was obtained as the sum of the individual homolog compounds:

$$\text{Total PCB} = \Sigma\, HOMOCL_i \qquad [1]$$

where $HOMOCL_i$ = Concentration of homolog (i)
i = Number of chlorines attached to the biphenyl molecule

The physicochemical properties of PCBs govern their behavior in the environment. Key properties include solubility in water, vapor pressure, octanol-water partition coefficient (K_{OW}, also referred to as Log P), bioconcentration factor (BCF), and degradation rate. Relative to other organic compounds such as aliphatic hydrocarbons, polycyclic aromatic hydrocarbons, and nonchlorinated pesticides, PCBs have much lower solubility in water, low vapor pressure (semivolatile), higher K_{OW}, very high BCF, and very low degradation rates (MacKay, Shiu, and Ma 1992). Because PCBs are very hydrophobic (readily come out of solution), persistent, and highly lipophilic (partition into lipids and organic carbon) they readily adsorb onto particles and build up in the food chain (bio- and geoaccumulation, Froescheis et al. 2000). The concept of fugacity, or the mass transfer of a chemical from one compartment (atmosphere, hydrosphere, geosphere, or biosphere) to another as a function of its chemical properties is usually used to model the behavior of PCBs in the environment (McKay, Shiu, and Ma 1992, Connolly et al. 2000).

PCBs have been implicated as toxic agents capable of affecting reproduction and endocrine function in birds, fish, and mammals (Johnson et al. 2000). Although not necessarily toxic at low concentrations, their capacity to accumulate in the environment means that organisms at higher trophic levels (higher in the food chain) are more at risk of toxic exposure to PCBs (Barnthouse, Glaser, Young, 2003). Recent evidence, reviewed and documented in a peer review workshop report on PCBs, suggests that some PCBs have dioxin-like properties that can lead to carcinogenic effects in mammals including humans (U.S. EPA 1996b).

3.2 Technical Working Group Studies

Since 1996, joint Navy and EPA Technical Working Groups have been working together as a team to gather data and perform technical analyses to address concerns about the potential release of PCBs from ex-Navy ships sunk in deep ocean during weapons testing exercises (SINKEX) and from ex-Navy ships sunk in shallow coastal waters to create artificial reefs (REEFEX). A number of studies were initiated, performed, and reviewed by working group participants including:

- A study of the potential human heath risk to active duty crew and shipyard workers exposed to solid materials containing PCBs in the performance of repair and decommissioning activities (Larcom et al. 1996), which showed that the level of risk for occupational health was acceptable.
- A modeling study on the release and fate of PCBs released from a Navy ship sunk in the deep ocean environment (Richter et al. 1994);
- A database of PCBs in solid materials present on Navy Ships (JJMA 1998, JJMA 1999).
- A human health and ecological risk conducted with data collected from the deep water SINKEX study of the ex-AGERHOLM (Gauthier et al. 2002, 2005);
- A detailed literature review of PCB levels measured in the sediments and biota of the deep ocean environment (Gauthier et al. 2005)
- A study conducted by the South Carolina Department of Natural Resources (SCDNR) of sunken vessels used to construct artificial reefs along the coast of South Carolina (Martore et al. 1998);
- Leachrate studies conducted to determine the leaching rate of PCBs from shipboard materials containing PCBs under shallow water conditions (George et al. 2005) and deep ocean conditions (high pressure and low temperature, George 2001a)

More recently, the REEFEX Technical Working Group developed information about assessing risks from ex-Navy ships sunk to create artificial reefs by conducting retrospective human health (NEHC 2004a) and ecological risk (Johnston et al. 2005) assessments of the ex-VERMILLION sunk off the coast of South Carolina in 1987.

The anticipated benefits of building reefs include enhancing ecological resources by increasing the amount of productive hard-bottom habitat, using artificial reefs as marine protected and conservation areas, or using artificial reefs to provide alternative reefs for recreational fishing and diving so that natural reefs can be protected and conserved (Bell 2001). Artificial reefs can also provide economic benefits to local communities by increasing tourism and commercial activities associated with fishing and diving on the reef (Jones and Welsford 1997, Enemark 1999). A study by the Rand Corporation (Hess et al. 2001) concluded that shallow water reefing would be the most ecologically responsible and economically feasible option for disposing of decommissioned warships. The report estimated that more than $1.5 Billion of taxpayer dollars would be saved if decommissioned ships could be “reefed” instead of “scrapped” (San Diego Oceans Foundation 2002a). In a follow up report, the authors predicted that the shallow reef disposal option would generate enough tax revenue to cover the costs of a 20-year reefing program within 12 years (Hynes et al. 2004).

Various standards and guidelines exist for reefing activities (Stone 1985). Canada has developed cleanup guidelines and standards for vessel disposal (Environment Canada 2001a, b), and environmentally based best management practices for preparing vessels to be sunk as artifical reefs is under development in the United States (U.S. EPA and MARAD 2004). By determining the potential ecological and human health risks, better decisions can be made to effectively manage the risks associated with creating reefs from ex-warships.

3.3 Environmental Conditions

The proposed location of ex-ORISKANY Memorial Reef is within the Army Corps of Engineers permitted Escambia East Large Area Artificial Reef Site (EELAARS) about 22.5 mi from Pensacola, FL (Figure 2). This site was selected by the Florida Fish and Wildlife Conservation Commission (FFWCC) based on 1) the exclusion of all active oil and gas lease blocks as requested by the U.S. Dept. of Interior’s Minerals Management Service, 2) a request by the U.S. Coast Guard to locate the sites at least two nautical miles away from any navigational fairway; 3) a Coast Guard requirement to provide for a navigational clearance of at least 50 feet; 4) Florida Department of Environmental Protection (FDEP) requirements to avoid known hard/live bottom areas and sea grass beds, 5) the shrimping industry’s requirements to avoid historic shrimp trawling areas, and 6) the ability to provide reasonable accessibility to the recreational fishing public (FFWCC 2004). The current plans are for the ship to be sunk approximately 24 miles south of Pensacola, FL in approximately 64 meters (204 feet) of water within the Army Corps of Engineers permitted Escambia East Large Area Artificial Reef Site. This ocean floor has been characterized as light brown sandy sediment with no live or hard bottom elements and is within the area managed by the Florida Fish and Wildlife Conservation Commission Artificial Reef Program[2].

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[2] Permit files and database records of the Florida Fish and Wildlife Conservation Commission Artificial Reef Program, 2590 Executive Circle East, Suite 203H Tallahassee, FL 32301. Provided by Jon W. Dodrill, Environmental Administrator, FWC Division of Marine Fisheries. (email Jon.Dodrill@fwc.state.fl.us. Ph. 850.922.4340 x 209)

There are no commercial fishing/trawling grounds, military restricted/testing areas, marine parks, marine reserves, aquatic preserves, and marine sanctuaries within 10 nautical miles of the EELAARS. According to the U.S. Department of Interior's Minerals Management Service, there is no known oil or gas submerged transmission crossings within the EELAARS and the site is over 2 nautical miles from the charted commercial fairways into Pensacola Bay. There is no direct evidence from the literature or through historic knowledge of local charter fishermen of the presence any extensive hard bottom areas within the EELAARS and the only submerged grasses in northeastern portion of the Gulf of Mexico are located within Escambia Bay, more than 23 nautical miles shoreward of the proposed sinking location. While small areas of isolated low relief, ephemeral hard bottom may exist within the EELASS, this type of live bottom is not well developed, contains no hard corals and is subject to burial and re-emergence as part of natural storm driven cycles (FFWCC 2004). Reef building activity in the EELAARS has been conducted by County, state, and federally funded public reef building efforts. These include artificial reefs constructed of concrete materials and modules, several steel hulled vessels, a decommissioned energy platform, and numerous public, private, and refugia reefs within the area (FFWCC 2004).Prior to sinking the Oriskany, drop down cameras and Ponar grabs will be used to verify the conditions of the bottom substrate at the proposed sinking site. Extensive use mapping of bottom topography within the area has revealed no bottom relief indicative of any developed reef structure. The existing bottom is described as composed of light brown sandy sediment with no hard/live bottom observed. Little subsidence of artificial reef materials has been noted on multiple dives in the area in recent years in the 80-110 feet depth range (FFWCC 2004).

3.3.1 Physical, Geological, and Biological Environment

The following information was excerpted from the State of Florida's letter application to obtain the ex-ORISKANY (FFWCC 2003):

> The Gulf of Mexico seafloor off northwest Florida consists of a quartzite sand veneer over a limestone substrate and is generally flat with a less than 5% slope to the south (offshore) towards De Soto Canyon. The specific site was chosen for the proposed artificial reef due to water depth and lack of presence of natural limestone rock outcroppings. The seafloor within this region of the Gulf of Mexico (GoM) was described by McBride et al. (1999) as Perdido Shoal, a relict deltaic accumulation of sand, presumably formed during a historic (probably Holocene) period of lower sea level. The proposed site for the USS Oriskany Memorial Reef is southeast of South Perdido Shoal. The keel of the vessel will rest along a north-south line at a depth of 212 feet. Due to the depth of the deployment location, no sediment depth probes have been obtained at the exact site but sediment probes taken in other areas of the Escambia East LAARS have indicated sand of varying depths over the limestone shelf. Typically, the sand is at least several feet thick. At isolated locations, the overlying sand veneer has been removed, forming rock outcroppings that provide natural reef habitat. Because the seafloor depth is greater than 200 feet, no substantial sand transport is expected to occur at the proposed artificial reef site. Although we expect the Oriskany to settle several feet into the seafloor, the extreme vertical profile of the ship would prevent substantial loss of reef habitat by subsidence or burial. Other large artificial reef structures in the area have not been negatively impacted by subsidence. As required by the reauthorization of the original Corps permit, the minimum navigational clearance will be 55 feet at Mean Lower Low Water

(MLLW) and greater at Mean High Water. The maximum tidal range at the proposed site is less than two feet.

Average monthly and annual wind speed, wave height, and other meteorological and oceanographic data in the vicinity of the proposed artificial reef site are measured by permanently moored buoys (NOAA NBDC). At buoy #42040 (64 n. mi south of Dauphin Island, AL), average wind speed is less than 10 knots in summer, and less than 15 kn (September – April). Annual average wind speed at Pensacola is 7.4 knots (NOAA, 2003). Wave data from buoy #42040 indicate that wave heights average 2-3 feet in summer, and 3-4 feet in winter (NOAA NBDC).

Water currents at the proposed site are generally very mild. Fringes and eddies of the Loop Current (easterly in summer, westerly in winter), wind and tidal action are the predominant sources of horizontal water movement in the northern Gulf of Mexico. Wind driven currents at the site are usually slight (<1/2 kn) and dissipate with depth. Tidal currents are likewise weakened due to the water depth (>200 ft) and distance from estuary outlets (>20 nmi). Occasionally, horizontal water movement may increase in the area for brief periods (up to several days), possibly caused by eddies from the Loop Current (Gore, 1992).

The Pensacola area experiences irregularly occurring large-scale weather events such as tropical storms and hurricanes, typically occurring from July through October. However, based on the depth of water in which the vessel is proposed to be placed, hydrodynamic forces acting on the sunken vessel are anticipated to be reduced compared to placement at shallower depths during hurricane events. Based on a site-specific stability analysis (Paul Lin Associates Stability Analysis Software; Factor of Safety = 1.25), the maximum wave heights modeled to occur during a 50-year storm event in the vicinity of the proposed sinking site are 25.9 feet with a period of 10.2 seconds (Corps of Engineers Wave Hindcast data). The site-specific stability analyses for both a broadside and head-on scenario indicate that the ship will remain stable during a 50-year storm event. Therefore, orientation of the ship is not a critical issue for reef stability. These analyses are presented as Attachment 1. This level of stability exceeds that specified by the FWC Administrative Rule 68E-9.004(4), F.A.C., which only requires demonstrated stability for a 20-year storm event. The model stability calculations are extremely conservative. The model applies a 1.25 safety factor to all calculations. In addition, the model does not account for the suction forces applied to the reef resulting from it settling into the substrate, which for a vessel of this size, will add significant additional resistance to rolling and sliding. Also, uplift wave forces acting on the flight deck are a major factor in vessel stability. Calculations utilize the maximum beam for the vessel, while the flight deck actually narrows as one moves towards the bow and stern from the angled deck.

Miami-Dade County Department of Environmental Resource Protection (DERM) conducted two independent additional stability analyses for the Oriskany for 190 and 215 feet depths off Southeast Florida. One stability analysis utilized the same FWC state model stability analysis software utilized for the proposed Oriskany Escambia LAARS sinking location. The second model, the Miami-Dade DERM model was a more refined version of the state model. Both models evaluated the stability of the Oriskany in 20, 50 and 100-year storm return intervals. The DERM model results, based on a 24.19 ft wave height with 9 sec wave interval, determined the Oriskany would be stable at both 215 feet and 190 feet if oriented broadside during a 50-year storm event. As with the State model, the reef was shown to be stable during a 100-year storm event if oriented bow into the anticipated general direction of the storm generated waves. The model also indicated resistance to overturning in a 100-year storm event, and resistance to sliding in a 50-year storm event in Southeast Atlantic waters. Based on similar wave criteria, these results are expected to apply to the Escambia East LAARS.

A study was performed on artificial reefs in an Escambia County artificial reef site after hurricanes Erin and Opal (Turpin and Bortone, 2002). Water depths in the study area were much less than at the proposed USS Oriskany Memorial Reef site (85 ft vs. 212 ft).

Although small, low-density artificial reef materials (e.g., steel frame shipping boxes and automobile bodies) were displaced by wave hydrodynamic forces, none of the steel barges and tugboats were displaced by Hurricane Opal (Saffir/Simpson Category IV). (Note: Hurricane Opal diminished in strength to a Category III by landfall, however, seas generated by the storm's Category IV winds impacted the artificial reef site.)

Excerpted from FFWCC (2003).

3.3.2 Federally Listed Species and Critical Habitat

The following are the federally listed species that may be present within the Gulf of Mexico:

Federally Listed Species[3]:

Listed Species	Scientific Name	Status	Date Listed
Blue whale	*Balaenoptera musculus*	Endangered	Dec. 2, 1970
Finback whale	*Balaenoptera physalus*	Endangered	Dec. 2, 1970
Humpback whale	*Megaptera novaengliae*	Endangered	Dec. 2, 1970
Sei whale	*Balaenoptera borealis*	Endangered	Dec. 2, 1970
Sperm whale	*Physeter macrocephalus*	Endangered	Dec. 2, 1970
Green sea turtle	*Chelonia mydas*	Threatened	July 28, 1978
Hawksbill sea turtle	*Eretmochelys imbricate*	Endangered	June 2, 1970
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered	Dec. 2, 1970
Leatherback sea turtle	*Dermochelys coriacea*	Endangered	June 2, 1970
Loggerhead sea turtle	*Caretta caretta*	Threatened	July 28, 1978
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	Threatened	Sept. 30, 1991
Smalltoothed sawfish	*Pristis pectinata*	Endangered	Apr. 1, 2003

The Offshore Environmental Assessment (OEA) prepared for sinking the ex-ORISKANY determined the following (NAVSEA 2004a):

[3]Endangered and Threatened Species and Critical Habitats under the Jurisdiction of NOAA Fisheries. http://sero.nmfs.noaa.gov/pr/pdf/Gulf%20of%20Mexico.pdf. March 8, 2004.

The biological resources in the vicinity of the site are characterized by habitats typical of many locations with sandy substrates in the northeastern Gulf of Mexico region. The area includes minimal coverage with live bottom habitats including soft corals and other reef species that may be present on limestone outcroppings that cover approximately three percent of the sea floor. However, FWCC has identified that the closest hard/live bottom outcropping is approximately 3,600 ft from the proposed site.

Fish Species: Spanish mackerel, red drum, jack crevelle, bonito, tarpon, speckled trout, red snapper, cobia, shark, black drum, sheephead, and flounder occur offshore of Florida and are important for fishing in the vicinity of the site. The most commercially and recreationally important fish species in the vicinity is the red snapper according to the FWCC. Shrimp and menhaden are also commercially important in the vicinity. The LAARS area currently has 24 manmade artificial reef locations that provide hard substrate materials for reef dwelling fish species. However, the closest artificial reef location is more than 1.5 nm from the proposed site. Protected habitats: Based on review of sources information available from NOAA and the OPIS Mapping Tool, no protected areas or critical habitat areas are listed as Marine Protected Areas in the eastern Gulf of Mexico region that includes the proposed site.

FWCC and ECMRD indicated that live bottom benthic habitats in the vicinity of the proposed site could include the presence of soft corals, non-reef building stony corals, sea fans, sea whips, and sponges. Outcroppings do not include tropical hard coral areas and are ephemeral in nature based on shifting sediments during storm events. Live bottoms attract other species such as sea turtles and mammals. The closest limestone outcropping was identified 3,600 ft from the proposed site.

In the offshore waters of the northern Gulf of Mexico, up to 29 marine mammal species may occur, including seven mysticetes, 21 odontocetes, and one exotic pinniped. This listing is based on an extensive review of sightings and stranding reports for the Gulf of Mexico (Jefferson and Schiro, 1997). The sperm whale is the only endangered cetacean likely to occur in the vicinity in the site. There is a resident population of sperm whales in the northern Gulf of Mexico.

Five species of sea turtles may occur in the vicinity of the proposed site location. All are protected under the Endangered Species Act (ESA). The hawksbill sea turtle (*Eretmochelys imbricato*), Kemp's Ridley sea turtle (*Lepidochelys kempii*), and leatherback sea turtle (*Dermochelys coriacea*) are endangered species. The loggerhead sea turtle (*Caretta caretta*) is a threatened species. The Atlantic green sea turtle (*Chelonia mydas*) is threatened, except for the Florida breeding population, which is endangered.

Excerpted from NAVSEA (2004a, pp 3-2 to 3-3).

3.3.3 Background Levels of PCBs

Ubiquitous contamination of PCBs in the environment (Tilbury et al. 2002, Froescheis et al. 2002, Looser et al. 2002, Johnson et al. 2000) has resulted in concentrations of PCBs in ecological systems that vary greatly across large regions from the Great Lakes (Jackson et. al 2001), Hudson River and New York Bight (Barnthouse et al 2003), to California (Froescheis et al. 2000) and the Pacific Northwest (West et al. 2001). A reliable estimate of reference and background conditions will allow the "incremental risk" posed by the site to be evaluated. In addition, an explicit definition of background and reference data developed prior to the assessment can help provide a context for interpreting the results of risk investigations (Judd et al. 2003). Therefore, it is very important to develop information about background and reference levels of PCBs for the ecosystem being evaluated. Background concentrations of PCBs are PCBs that are present in the environment due to processes, sources, and human activities that are not related to releases that will occur at the proposed artificial reef site (CNO 2004, BMI et al. 2003).

An important source of background data available for the assessment is data reported as part of the U.S. EPA's Environmental Monitoring and Assessment Program (EMAP) national monitoring program. One of the more advanced monitoring programs is the coastal and estuarine monitoring program. Data available from these studies can provide information that can be used to evaluate contaminant trends in biota and develop an overall assessment of the environmental conditions in the various regions of the US (Figure 5). Although EMAP is focused on coastal areas and estuaries, which can have relatively high levels of pollutants, the sample program also included many pristine and unimpacted locations as well (Hyland et al. 1998).

Regional background data were evaluated assess the current levels of PCBs in marine biota within coastal areas of the Gulf of Mexico and SE US. EMAP data available for the Louisianan and Carolinian Provinces through the EMAP website (Figure 5) were used to evaluate trends in PCB contamination levels in coastal fishes (Atlantic croaker — *Micropogonias undulates*, spot — *Leiostomus xanthurus*). In addition, some data were also available from the Florida Fish and Wildlife Research Institute (FFWRI 2004) Inshore Marine Monitoring and Assessment Program (IMAP) for 3 fish samples (spot, sea trout, and sea robin) collected from coastal areas near Pensacola, FL.

In the EMAP and IMAP programs 18 PCB congeners were quantified in the tissue and sediment samples (Wade et al. 1993). Total PCB (tPCB) was calculated as (T.L Wade, Geochemical and Environmental Research Group, Texas A&M University, personal communication[4]):

$$\text{Total PCB} = 2.19 \times \text{sumPCB} + 2.19 \qquad [2]$$

where sumPCB = the sum of the measured congeners (ng/g dry weight)

The total PCB concentrations measured in Atlantic croaker from the Louisianan Province averaged 0.01 mg/Kg wet weight (range 0.001 – 0.217) and the concentrations of PCBs measured in Atlantic croaker from Floridian waters averaged 0.009 mg/Kg wet weight range (0.001 – 0.071) (Table 1). In general, similar levels of PCBs were measured in fish sampled from the SE U.S. with the highest levels being reported from Texas, Louisiana, Florida, and the Carolinian Province (Figure 6).

[4] The equation for total PCB (tPCB = 2.19sumPCB + 2.19) was obtained by NOAA's Status and Trends Program from a regression of empirical data from samples that were analyzed for both individual congeners (sumPCB) and total aroclors (tPCB) (NOAA 1991).

3.4 Ship Preparation

The U.S.S. ORISKANY (CVA 34) is an 888-foot aircraft carrier that was commissioned in 1950, served during the Korean and Vietnam Wars, and was decommissioned in 1976 (DON 2001). In preparation for use as an underwater reef the ex-ORISKANY underwent an extensive cleanup and preparation program in accordance with the draft Best Management Practices for Preparing Vessels Intended to Create Artificial Reefs (US EPA and MARAD 2004). Vessel preparation involved removal of fuels, oils, loose asbestos containing material, capacitors, transformers or other liquid polychlorinated biphenyl (PCB) components, batteries, HALON, mercury, antifreeze, coolants, fire extinguishing agents, black and gray water, and chromated ballast water (NAVSEA 2004b, Figure 7). Due to the presence of PCBs found in the wooden flight deck and underlayment, much of flight deck and underlayment was removed and disposed of (Figure 8). Prior to vessel preparation the amount of PCBs contained within solid materials onboard the vessel were estimated to range from 377.5 Kg to 699.6 Kg (832.2 to 1542.3 lbs, average to 95% upper confidence level – UCL, Table 4, Pape 2004). Following the removal of 100% of the lubricants, 72.6% of the bulkhead insulation, 10% of the cabling, and 5% of the paints the total amount of PCBs remaining in solid materials onboard the vessel ranged from 327.79 to 608.85 Kg (722.7 to 1342.3 lbs, average to 95% UCL, Figure 9). More than 97% of the PCBs remaining on the vessel are associated with electrical cabling.

The leach rates obtained from the leachrate study (George et al. 2005) were used to model the release of PCBs from the solid materials. The time-varying release rates over the first two years following sinking were used in the TDM model (NEHC/SSC-SD 2005b). The steady state release rate was simulated in PRAM using the upper bound estimate of the release rate at two-years if the homolog data indicated a statistically significant regression between time and release rate, otherwise the maximum observed leach rate was used (NEHC/SSC-SD 2005a). The fraction of PCBs in the materials on the ex-ORISKANY were estimated using a detailed statistical analysis of the data reported in Pape (2004) to derive an estimate of the 95% UCL of the source material (see Section 3.2, Table 10, and Figure 11 of NEHC/SSC-SD 2005a). The loading rate was obtained by multiplying the grams of PCB contained within each solid by the solid-specific leach rate observed for each homolog, and by summing, the amount of total PCBs released in ng PCB per day (Table 5, NEHC/SSC-SD 2005a, b). Because the leach rates measured for homologs in bulkhead insulation were much higher than the other materials, the bulkhead insulation will leach proportionally more PCBs than the other materials. In fact, vessel cleanup significantly reduced the amount of PCBs that could be released by removing the majority of bulkhead insulation present on the ship (Figure 10). The electrical cabling which accounts for the vast majority of PCBs present has a very low leach rate, so electrical cabling only accounts for about 10% of the PCBs expected to be released.

4. Problem Formulation

4.1 Conceptual Model and Exposure Pathways

The potential exposure pathways and assessment endpoints evaluated are shown in Figure 10. Contaminants can enter the system from releases from the sunken vessel. Because the sunken vessel is not isolated from coastal contamination sources, contamination at the sunken ship reef could come from other sources besides the sunken vessel itself. While other sources of contamination may be important in future monitoring of the site, this pathway was not evaluated in the risk assessment for the ex-ORISKANY.

Any PCBs contained in solid materials on the ship could be released from the sunken vessels during or after the process of sinking, and it was assumed that the release rates would be similar to the empirical release rates observed in the materials studied in the laboratory leachrate experiments (George et al. 2005). The PCBs released were expected to be well mixed in the interior vessel water where they would be advected, as function of the bottom current, and mixed into the lower water column surrounding the vessel and extending up to the pycnocline and out to the edge of the zone of influence (ZOI, see below) of the reef. Within the lower water column the PCBs would partition to sediment, sediment pore water, total suspended solids (TSS), and dissolved organic carbon (DOC) in the water column, and exchange with water, TSS, and DOC in the upper column. Organisms attached to the ship, free-swimming in the lower and upper water column, and on and within the sediment bed would be exposed to the PCB concentrations present. Advection from bottom currents and exchange across the air-sea boundary on the surface would transport PCBs beyond the boundary of the reef. The interior of the vessel was interpreted as the interior compartments of ship (Figure 8), the spaces separated from the water column by bulkheads, passageways, and hatches. The hangar-deck and other spaces that are open to ocean currents were considered to be the exterior of the ship. These are the primary surfaces that will be used as substrate by colonizing reef organisms where they will be exposed to PCB concentrations in the lower water column.

Depending on the nature of the contamination, PCBs may be present in various media, i.e., water, sediment, and biota, through transport, uptake and bioaccumulation (ingestion of prey). These media may pose a risk to valued and relevant ecological resources and humans if the exposure pathway is complete. Exposure to contaminants present in the water column could occur to marine organisms through contact and uptake (e.g. gill tissues) and to higher-level predators by ingestion of contaminated prey and incidental contact. PCBs can also accumulate in the sediments from sorption and settling and cause exposure to benthic invertebrates. Another possible route of exposure for encrusting alage and invertebrates is from direct contact with the surface of the ship (Figure 10).

Reef building increases the biomass per unit area because the pre-existing habitat (sandy bottom continental shelf) does not provide favorable substrates or habitat for high-density populations of reef-dwelling marine species (Bell 2001). The sunken vessel provides habitat for reef-dwelling organisms, as well as additional resources to the existing fauna. From an ecological perspective, the valued resources or ecological receptors to protect are the species that might be affected by the sunken vessel and their relationships with other valued species in the local or regional marine ecology. Species that could be impacted by exposure from contaminants include marine species that have migrated to the artificial reef or transient marine species that visit the reef.

4.2 Assessment Endpoints and Receptor Species

An assessment endpoint is defined to encompass a component of the ecosystem that may be impacted by the stressors of concern, has high ecological and/or societal value, and represents a component of the ecosystem that can be protected (Suter 1993). Generally considered to symbolize valued environmental conditions or processes, assessment endpoints usually cannot be directly quantified (Suter 1993, U.S. EPA 1992). Instead, data on exposure levels and information that relates the exposure to the ability to cause effects to the assessment endpoint are needed to perform the risk assessment (U.S. EPA 1998d). For the ecological system under consideration, primary exposure and indirect exposure through bioaccumulation in the food chain can occur to the pelagic, benthic, and reef communities and as well as other ecological consumers that could be attracted to the abundance of food at the reef.

The PRAM and TMD models were specifically developed to model PCB releases from the ship and accumulation of PCBs in the abiotic and food chain of the pelagic, benthic, and reef communities (Figure 10). The assessment endpoints were developed to assess the potential effects to survival, growth, and reproduction to the communities and organisms modeled by PRAM as well as ecological consumers that could also feed and forage at the reef. The assessment endpoints modeled by PRAM (Table 2) were concentrations of PCB homologs in water, sediment, primary producers (Trophic Level – TL=1, phytoplankton and encrusting algae), primary consumers (TL=2, copepod, bivalve, urchin, polychaete, and nematode), secondary consumers (TL=III, herring, triggerfish, lobster, and crab), and tertiary consumers (TL=IV, jack, grouper, and flounder). By grouping organisms according to their habitat and diet preferences, PRAM also provided data to evaluate the pelagic, benthic and reef communities (Table 2). Additional endpoints for other ecological consumers included avian consumers (cormorant and herring gull), sea turtles (loggerhead turtle), dolphins (bottlenose dolphin), and sharks (sandbar shark and barracuda, Table 3, Figure 10). Representative species were used to relate exposure levels to potential effects to the assessment endpoint. Considerations for selection of receptor species for the ecorisk screening included the availability of data and toxicological information. Additional criteria, such as the importance of the receptor to the ecology, its sensitivity to PCBs, its link in the food web, and its aesthetic and/or commercial importance as a natural resource were also considered.

The receptor species were evaluated to assess PCB exposure to species that comprise the reef community. The receptor species used in this risk assessment were selected to be representative of species found at the reef that would be sensitive to contaminant exposure and for which exposure and effects data would be available or could be inferred. Because this risk assessment was concerned with evaluating toxicological risks associated with exposure to PCBs (especially PCBs migrating through the food chain), the primary ecological effects to the assessment endpoints evaluated were survival, reproduction, and individual growth and development. Evaluating ecological effects to other valued ecological entities, such as species diversity, primary productivity, or aquatic populations was possible only to the extent that the benchmarks (see Section 5) were also protective of those attributes. This risk assessment only evaluates the potential effects of contaminant exposure and does not address the presence and physical structure of the artificial reef, which greatly influences the ecological processes present at site.

To the extent possible, receptor species were representative of mammals, birds, reptiles, fishes, and invertebrates that utilize reef habitats. In many cases, toxicological data were not available for reef organisms and the susceptibility of the receptor species to PCBs had to inferred or extrapolated from species used in toxicological tests and studies (mainly freshwater and estuarine species).

4.2.1 Reef Community

The reef community is the community of organisms that live and associate with the reef. The community is composed of many fish, invertebrates, and plants. Many reef organisms spend most of their life on the reef, others may migrate over vast distances between reefs, and others may be larval or juvenile life stages of bottom dwelling organisms that will eventually settle out of the water column onto the reef before reaching maturity. Exposure to the reef community occurs from water-borne contaminants and/or contaminated sediment, which may accumulate on the reef, and to contaminants that accumulate in the food chain (Figure 10). Based on the life history and feeding behavior of different classes of reef organisms, there will be different exposure scenarios for the pelagic, benthic, and reef communities associated with the reef.

4.2.1.1 PRIMARY PRODUCERS

If light can penetrate to the depth of the reef, phytoplankton, benthic diatoms, encrusting algae, and other marine plants will be present on the reef. The phytoplankton in the water column around the reef and encrusting algae growing on the reef form the basis of the reef food chain. The primary producers can be exposed to contaminants in the water column and to contaminants that may come into contact with roots and holdfasts of marine macro flora, if present. Water column benchmarks are based on water quality criteria, which have been developed to be protective of aquatic species including phytoplankton and encrusting algae. Contaminant concentrations estimated for water column exposures were used to assess ecological risk to primary producers of the reef (i.e. water column benchmarks are protective of both plants and animals).

4.2.1.2 PRIMARY CONSUMERS

Primary consumers on the reef include zooplankton, epifauna, infauna, and grazing fish. Zooplankton, the tiny crustaceans, mollusks, and other larval vertebrates and invertebrates that feed on phytoplankton and detritus comprise a key link in the reef food chain. Primary consumers also include other water column grazers such as pelagic and midwater bait fishes that feed primarily on phytoplankton. Zooplankton and other grazers can be exposed to contaminants in the water column, suspended sediments, and bedded sediments. The reef community includes a wide diversity of benthic and epibenthic invertebrates that live on, below, and above the reef. If sedimentary deposits are present, benthic invertebrates that live by burrowing and feeding in the sediment and foraging along the bottom would colonize the sediment. Benthic organisms are directly exposed to any contaminants that become attached to particles and are deposited in the sediment. Epibenthic invertebrates live on the surface of the bottom and on rocks, ledges, and artificial substrates sitting on the bottom. Many epibenthic invertebrates are sessile organisms, which are attached to hard surfaces for the majority of their life span. Epibenthic organisms are exposed to contaminants present in the water column, contaminants present on the surface of the substrates to which they are attached, and contaminants accumulating in the food chain. The primary consumers will also accumulate contaminants present in their food. Water column benchmarks are based on water quality criteria, which have been developed to be protective of aquatic species.

4.2.1.3 SECONDARY CONSUMERS

Secondary consumers include carnivorous fish and invertebrates such as grunt, snapper, sea bass, toadfish, lobster, and crabs that live on or near the bottom and are closely associated with the reef. Secondary consumers also include organisms such as pelagic fishes and sea turtles that may be attracted to the reef to forage on the primary consumers present on the reef. Secondary consumers are exposed to contaminants present in the water column, associated with the sediment, and concentrated in prey.

Sea turtles such as loggerheads (*Caretta caretta*) may frequent reef habitats to take advantage of the relative abundance of food. Listed as a threatened species in U.S waters and an endangered species worldwide, loggerheads feed on a wide variety of invertebrates by using their powerful jaws to crush the shells of molluscs, barnacles, and crabs (Bolten and Witherington 2003, Turtle Trax 2004).

4.2.1.4 TERTIARY CONSUMERS

Tertiary consumers are the organisms that primarily feed on the secondary consumers present on the reef. The tertiary consumers are the top of the reef food chain; they are exposed to contaminants in the water and the sediment as well as contaminants that may be accumulating in the food chain. The top level predators at the reef include reef residents such as groupers, eels, and octopi as well as other predators such as sharks, barracuda, sea turtles and marine mammals that may be attracted to feed on the abundance of food present at the reef.

Some marine mammals that may frequent reef habitats include dolphins, porpoises, and possibly toothed whales (odontocetes). Since whales migrate over vast distances of the ocean and most porpoises are wide ranging pelagic species, it is not very likely that these species would be commonly found in the reef areas. The worst-case exposure to a marine mammal would be from dolphins that could be attracted to the reef area by the abundance of food. Marine mammals (dolphin) can consume demersal fish and free-living invertebrates and incur incidental exposure to water- and sediment-borne contaminants.

4.2.2 Avian Consumers

Avian consumers (cormorants and herring gulls) may also be attracted by the abundance of food to feed and forage on the reef. While most avian predators would consume primary consumers (pelagic and bait fishes) some avian predators may consume secondary consumers such as demersal fish, midwater fish, and some invertebrates. Avian predators are exposed to contaminants in the food chain, and they may be exposed to water-borne contaminants while foraging. The receptor species for avian piscivore was the double-crested cormorant (*Phalacrocorax auritus*) and the receptor species for avian omnivore was the herring gull (*Larus argentatus*).

5. Ecorisk Methodology

5.1 Overview

Output from the TDM and PRAM models were used to evaluate ecological risks to the reef community and other ecological consumers that may feed and forage on the reef. Output from the TDM and PRAM provided the concentration of PCBs in the abiotic components of the environment and tissue concentrations in representative species expected to be present in the food chain associated with the reef (Table 2). These data were used to assess potential ecorisks to the assessment endpoints associated with the artificial reef (Table 3). Assessment endpoints include sediment and water exposure and components of the food chain modeled by PRAM (Table 3a), as well as reef and avian consumers not directly modeled by PRAM (Table 3b). Risks from sediment and water exposures modeled by TDM and PRAM were evaluated by comparison to sediment and water benchmarks. Risks to assessment endpoints modeled in the PRAM food chain were evaluated by comparison to benchmarks protective of tissue residue exposures and risks to reef and avian consumers were evaluated by benchmarks protective of dietary exposure.

Short-term (0 – 2 years) risks were evaluated with output from TMD-PRAM for the progressive food chain scenarios modeled to simulate potential food chain accumulation during the initial transient release following sinking. The output of TDM-PRAM was evaluated using the estimated accumulation of PCBs modeled after 1 day, 1 week (7 days), 2 weeks (14 days), 1 month (28 days), 6 months (180 days), 1 year (365 days) and 2 years (729 days) for 15 m, 45 m, and 60 m from the hull. Long-term ecological risks were evaluated using the steady-predictions obtained from PRAM with a ZOI=1 (0 m), ZOI=2 (15 m), and ZOI=3 (27 m). The modeled concentrations were compared to the ecorisk benchmarks to evaluate potentially harmful exposures to PCBs.

5.2 Selection of Benchmarks

Benchmarks were selected to evaluate potential effects of PCBs to a broad range of reef-dwelling organisms. Benchmark concentrations for water (W_B), sediment (S_B), and tissue residues of fish (T_{Fish}) and invertebrates (T_{Invert}) were selected. The tissue benchmarks were for the bioaccumulation critical value (B_{CV}), tissue-screening value (TSV), critical body residues

(CBR) corresponding to the no observed effect dose (NOED) and the lowest observed effect dose (LOED) for a fish or invertebrate species. Benchmarks of ecological effects to assess dietary exposure to representative secondary and tertiary consumers and avian consumers were also developed. Dietary benchmarks for fish as prey were developed for herring gulls (D_{Gull}), cormorants ($D_{Cormoant}$), dolphins ($D_{Dolphin}$), and sharks and barracuda (D_{Shark}). Dietary benchmarks for invertebrates as prey were also developed for herring gulls (D_{Gull}), sea turtles (D_{Turtle}) and dolphins ($D_{Dolphin}$) (Table 6).

5.2.1 Water Exposure

Water quality criteria, the basis of the water exposure benchmarks, were developed to be protective of both short-term (acute) and long-term (chronic) exposure. The criterion continuous concentration (CCC – chronic) “is an estimate of the highest concentration of a material in the water column to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect” and the criterion maximum concentration (CMC – acute) “is an estimate of the highest concentration of a chemical in the water column to which an aquatic community can be exposed briefly without resulting in an unacceptable effect” (U.S. EPA 1995).

Water quality standards have been developed to be protective of 95% of the species tested, or more precisely, of the genera tested (U.S. EPA 1991, 1994). The water quality criterion for PCBs is defined as total PCBs (Total PCB), which “is the sum of all homolog, all isomer, all congener, or all Aroclor analyses” (U.S. EPA 2002). The aquatic life criteria recommended by national water quality criteria for saltwater continuous (WQC-Chronic) concentrations is 0.03 ug/L and maximum (WQC-Acute) is 10 ug/L (U.S. EPA 1998b, 1999b, summarized in Buchman 1999). The Great Lakes Water Quality Initiative criteria for protection of wildlife (GLWQI-Wildlife), which takes into account bioaccumulation in fish for wildlife exposure, has recommended the criteria for Total PCB of 0.074 ug/L (GLWLC-Tier1[5]) and 0.14 ug/L (GLWLC, U.S. EPA 1995).

Recently, the State of Florida has proposed enacting water quality standards for persistent, bioaccumulative, and toxic contaminants such as PCBs to be protective of an exposure equivalent to the “risk of one in a million or a Hazard Index of 1.0 for the 90th percentile of all Florida adults eating fish species found in Florida waters” (FLDEP 2004). The proposed standard for the annual average ($FLWQC_{aap}$) exposure to Total PCB is 0.000023 ug/L, which is factor of 2 lower than the current annual average standard of 0.000045 ug/L ($FLWQC_{aa}$, F.A.C. 62-302.530) and 3 orders of magnitude lower than the recommended aquatic life chronic criteria. The chronic criteria of 0.03 ug/L is equal to the Florida State Standard for maximum concentration of Total PCB ($FLWQC_{max}$, F.A.C. 62-302.530).

[5] Tier I refers to the initial screening level concentration recommended by the Great Lakes Water Quality Initiative.

The chronic value of 0.03 ug/L (WQC-Chronic) recommended by the national guidance as protective of aquatic organisms was used as the most conservative ecorisk benchmark and the Great Lakes Tier1 wildlife criteria of 0.074 ug/L (GLWLC-Tier1) was used as the less conservative ecorisk benchmark. The WQC-Chronic value was also used to calculate the bioaccumulation critical value (B_{CV}) to evaluate potential toxic effects from PCB exposure to aquatic life (see Section 5.2.3 and Table 8).

The water exposure benchmarks were used to evaluate potential ecological effects to primary producers (phytoplankton and encrusting algae), primary consumers (zooplankton and grazers), as well as other components of the reef community (fish and invertebrates). It was assumed that the water benchmarks were applicable and appropriate for protection of the reef community.

5.2.2 Sediment Exposure

The benchmarks for sediment exposure to PCBs (S_B, Table 6) were set to the Threshold Effects Level (TEL) and Probable Effects Level (PEL) recommended by Florida Sediment Quality Assessment Guidelines (SQAGs, MacDonald 1994a, b). The TEL and PEL were developed from studies where chemical concentrations in the sediment and ecological effects were measured or modeled. The TEL represents the concentration of a chemical below which effects are not expected, the PEL represents the concentration that is likely to cause ecological effects, and the "possible effects range" is defined for chemical concentrations between the TEL and PEL (MacDonald 1994a, b, Long et al. 1995, U.S. EPA 1996a, Buchman 1999).

The sediment benchmarks were used to evaluate PCB exposure to primary producers (benthic diatoms, encrusting algae), primary consumers (benthic infauna and epifauna) and other components of the reef community that would come into contact with sediments associated with the reef (free swimming fish and invertebrates). The sediment benchmarks for PCBs were based on Total PCB exposure characterized by the sum of the measured congeners (sumPCB) converted to Total PCB using empirical relationships[6] (NOAA 1991, Long and Morgan 1990). It was assumed that the sediment benchmarks were applicable and appropriate for protection of the reef community.

5.2.3 Tissue Exposure

Tissue residue benchmarks were based on bioaccumulation critical values (B_{CV}), tissue screening values (TSV), critical body residues, and dietary uptake benchmarks. These benchmarks (Table 6) are chemical residue thresholds at or below which adverse toxicological effects would not be expected.

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[6] The equation for total PCB (tPCB = 2.19sumPCB + 2.19) was obtained by NOAA's Status and Trends Program from a regression of empirical data from samples that were analyzed for both individual congeners (sumPCB) and total aroclors (tPCB) (NOAA 1991).

5.2.3.1 Tissue Screening Values (TSV)

Tissue screening values (TSV), originally developed for screening-level ecorisk assessments at Navy sites (URS 1996, 2002), are the concentrations of chemicals in the tissue of an organism at or below which adverse effects would not be expected to occur. The TSV is based on water quality criteria that were derived to be protective of aquatic organisms (U.S. EPA 1986, URS 1996, Shepard 1998, Dyer et al. 2000). Because the TSV is equal to the no effect tissue concentration, a single TSV applies to both freshwater and marine organisms (URS 1996), in other words the same tissue concentration would cause an effect regardless of whether the organism was a marine or freshwater species. This assumes that the difference between freshwater and saltwater criteria are due to differences in chemical uptake in freshwater and marine organism and not differences in tissue concentrations that would cause adverse effects. The TSV for PCB was developed using conservative assumptions about contaminant uptake and potential effect and were calculated as (Table 7):

$$TSV = WQC\,\frac{\mu g}{L} \times BCF_a\,\frac{L}{Kg(wet)} \times 0.001\,\frac{mg}{\mu g} \quad [\text{mg/Kg wet weight}] \qquad [3]$$

Where

BCF_a = bioconcentration factor for aquatic organisms (L/kg wet weight) normalized to the average (3%) lipid content[7] of aquatic organisms (URS 1996)

WQC = was selected as the lowest value reported for marine or fresh water quality criteria (μg/L) that was in effect at the time the TSVs were calculated (URS 1996)

Chemical residue levels below the TSV are assumed to pose little or no risk to aquatic biota (Shepard 1995, URS 1996, Dyer et al. 2000).

5.2.3.2 Bioaccumulation Critical Values (B_{CV})

Bioaccumulation critical values (B_{CV}) were based on empirical relationships between chemical exposure and organism uptake and accumulation (Table 8). Similar in concept to the TSV, the B_{CV} was calculated using the most recent salt water quality criteria for chronic exposure to PCBs (U.S. EPA 1999a, Buchman 1999) and bioconcentration factors applicable to marine fish and invertebrates. The B_{CV} was defined as the tissue concentration that would occur if water exposure levels reached the chronic value of 0.03 ug/L TotalPCB recommended by the national guidance as protective of aquatic organisms (W_B):

[7] The BCF for PCBs (log BCF = (0.85 x logKow) – 0.70) was determined from experiments conducted with using fathead minnows (*Pimephales promelas*) with an average lipid content of 7.6 % (U.S. EPA 1980, URS 1996). Freshwater and marine organisms that are commonly consumed in the US have a weighted average of about 3% lipid content (U.S. EPA 1980, URS 1996). Therefore to make the BCF for PCB more applicable to water quality criteria the U.S. EPA adjusted the BCF value by 3%/7.6% = 0.395 (URS 1996).

$$B_{CV} = W_B \frac{\mu g}{L} \times BCF_M \frac{L}{kg(wet)} \times 0.001 \frac{mg}{\mu g} \quad [mg/Kg \text{ wet weight}] \qquad [4]$$

where W_B = Most recent salt water chronic criteria (EPA 1998, Buchman 1999, see Table 6)

BCF_M = bioconcentration factor for marine organisms (L/kg wet weight), see Table 8

The BCFs used for invertebrate tissue were obtained from URS 1996 and the fish tissue BCF for TotalPCB was estimated from Mackay (1982, cited in Petersen and Kristensen 1998):

$$\log(BCF_{ww}) = -1.32 + \log(Kow) \qquad [5]$$

BCF_{ww} = bioconcentration factor in adult fish in wet weight basis

The B_{CV} for total PCB (tPCB) accumulation in fish and invertebrate tissue was calculated using a BCF weighted by the fraction of tPCB (f_{tPCB}) present in each homolog group measured in reef fish sampled in the REEFEX study for the ex-VERMILLION (Figure 12, Table 9). The BCF was calculated as:

$$BCF_{tPCB} = \Sigma f_{tPCBi} \times BCF_i \times 0.64 \text{ [L/kg wet weight]} \qquad [6]$$

Where i is the index for each homolog group mono through deca (Table 9) and 0.64 is a lipid-normalizing factor used to normalize the lipid content of vermilion snapper (4.7%) to 3%. EPA uses 3% as the average lipid content of aquatic organisms to determine the water quality criteria value for PCBs (U.S. EPA 1980, URS 1996, Table 9).

5.2.3.3 Critical Body Residues

Critical body residues (CBR) are defined as the threshold concentration of a contaminant in the tissue of an organism above which adverse effects could occur (McCarty et al. 1992, Pabst 1999). Generally, the effect occurs as a result of narcosis (noncancer effects) and can result in death (mortality), or a reduction in fecundity, reproduction, or growth (chronic effects). Data from the US Army Corps of Engineers Environmental Residue-Effects Database (ERED 2002, see http://el.erdc.usace.army.mil/ered/) were used to develop benchmarks for critical body residues. The database was searched for effects from PCBs on reproduction, growth and development, mortality and survival. Results that were based on adult exposure, whole body concentration, and ingestion or absorption were used, if available (Appendix A). Benchmarks were selected for highest no observed effect dose (NOED) and lowest observed effect dose (LOED) for the receptor species of interest (i.e. fish and invertebrates,).[8] If the highest NOED was greater than the lowest LOED, then a NOED was selected that was lower than the lowest LOED (Table 6, Table 10, Table 11). The NOED and LOED benchmarks for fish and

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[8] NOED and LOED are used to be consistent with the ERED nomenclature, which defined "dose" as the whole body burden concentration. Values selected from the database were the no observed adverse effects (NOED) and lowest observed adverse effect (LOED).

invertebrates were derived by multiplying the value obtained from ERED [mg/Kg wet weight] by an uncertainty factor (UF), if applicable

$$NOED = NOED_{ERED} \times UF \qquad [7]$$
$$LOED = LOED_{ERED} \times UF \qquad [8]$$

The NOED for fish was based on sheepshead minnow and the fish tissue LOED was based on lake trout data. The NOED for invertebrates was based on mussels and the invertebrate tissue LOED was based on toxicity to grass shrimp. Because the exposure levels were assumed to be directly applicable to reef organisms being evaluated in the ecorisk assessment an UF=1 was used in calculating the NOED and LOED benchmarks (Table 10, Table 11, Appendix A).

5.2.3.4 Food Chain Benchmarks

The potential for bioaccumulative contaminants to affect higher trophic levels was evaluated by assessing contaminant concentrations in tissues of representative prey. The exposure to an upper trophic level predator (bird of prey, dolphin etc.) is related to the exposure from eating prey species (clam, fish, worm, etc.) that have bioaccumulated contaminants from exposure pathways present within the reef community (Figure 11).

For cormorant, herring gull, and dolphin the food chain benchmarks were set to correspond to the dose that is equivalent to the no observed adverse effect level (NOAEL) for the receptor species. If available, Toxicity Reference Values (TRVs) were used to determine potential adverse exposure to predators. No applicable TRVs are currently available for reptiles (Chris Salice, U.S. EPA, personal communication) so the lowest mammalian or avian TRV for PCBs was assumed to be protective of sea turtles after converting to account for body weight and intake rate of sea turtles. This approach assumes that benchmarks protective of avian and mammalian species would also be protective of reptiles (see Great Lakes Water Quality Initiative Methodology for the Development of Wildlife Criteria, U.S. EPA 1995, CFR 40 part 132). For shark and barracuda the food chain benchmark was based on the dietary dose that corresponded to the concentration in the diet that would result in the NOED or LOED concentration for the most similar species available from the ERED database (Appendix A). The NOED was based on the no effect level reported for striped bass (*Morone saxatilis*, Westin et al. 1983) and the LOED was based on reduced growth to winter flounder (*Pseudopleuronectes americanus*) larvae (Black et al. 1998).

When a NOEAL or NOED is used to calculate the TRV, the TRV represents a chemical concentration below which significant effects to the receptor are not anticipated. When the LOEAL or LOED is used to calculate the TRV, the TRV represents a chemical concentration above which ecological effects to the receptor could occur.

Water exposure was not evaluated for birds, mammals, and sea turtles. None of these species have gills, which is the main route of contamination from water exposure for marine fish and invertebrates. For birds, incidental contact with the water would occur when foraging at the reef (diving and swimming), but it was assumed that this exposure would not be significant. Although dolphins and sea turtles could also be attracted to forage at the reef for long periods, they are not considered to be reef residents and it was assumed that uptake of contaminants from the water would be negligible and could be ignored. Water exposure for the reef shark and barracuda was evaluated by assuming that potentially harmful tissue concentrations (NOED, LOED) could arise by accumulating contaminants from water and food.

The TRVs for the omnivorous herring gull (*Larus argentatus*) and piscivorous double-crested cormorant (*Phalacrocorax auritus*) were used to develop benchmarks for dietary exposure from the consumption of prey tissues. Dietary benchmarks for avian consumers were developed using the highest dose that caused no observed adverse effects (NOAEL, microgram of chemical per gram of bird's body weight per day in wet weight) to the most sensitive taxonomically similar bird species, primarily, mallard duck (*Anas platyrhynchos*) (Table 12, Table 13, Sample et al. 1996). The TRV for exposure to PCBs was based on toxicological studies on ring-necked pheasants (*Phasianus colchicus*, Table 12, Table 13, Sample et al. 1996). Introduced into North America from Asia, ring-necked pheasants consume a wide variety of plants (seeds and grains) and animals including insects (grasshoppers, crickets, and ants are the primary food for young chicks) and occasionally small snakes and rodents (USFS 2004). Although ring-necked pheasants have a very different diet that seabirds, they are about the same size (1 kg) and have the about the same dietary needs (Sample et al. 1996) as herring gulls (body weight of 1.1 g and a dietary intake of 264 g/d, U.S. EPA 1995) and cormorants (body weight 1.9 g and a dietary intake of 475 g/d, Environment Canada 2004c). Herring gulls are opportunistic feeders and will consume virtually any available food (U.S. EPA 1995) while double-crested cormorants feed almost exclusively on fish (Environment Canada 2004c). The avian benchmarks assumed that PCBs would have similar toxic effects and mode of action in herring gull and cormorant as was observed in the test species, after converting the dose for body weight and ingestion rate (see below).

The mink (*Mustela vison*) was selected as the most similar mammalian test species to dolphins. Minks are voracious carnivores, a large component of a mink's diet consists of fish (Sample et al. 1996), and mink are more similar to dolphins than other mammalian species for which toxicology data are available, such as laboratory rats, white-footed mice, and oldfield mice (Sample et al. 1996). Additionally, mink are more sensitive to PCBs than laboratory rats or white-footed mice (Sample et al. 1996).

Depending on the availability of food, bottlenose dolphins (*Tursiops truncatus*) will eat a wide variety of food including tarpon, sailfish, sharks, speckled trout, pike, rays, mullet, and catfish. They are also known to eat anchovies, menhaden, minnows, shrimp, eel and other free-swimming invertebrates. The average dolphin will consume 18-36 kg of fish each day (Davis and Schmidl 1997). The most common feeding behaviors is foraging; bottlenose dolphins are also known to chase prey into very shallow water where they can capture the trapped fish by lunging onto mud banks and shoals (Davis and Schmidl 1997). Adult bottlenose dolphins average 2.5-3 m (8-10 ft.) and weigh between 136-295 kg (300-650 lb.), with males being slightly larger than females (Seaworld 2000).

Experimentally derived toxicity values for mammals (minks - $NOAEL_{mink}$) were converted to effects levels for dolphins ($EL_{Dolphin}$) by scaling the dose to the ratio of body weight of the test species to the body weight of the receptor species using an empirical relationship (Equation [9], Sample et al. 1996). Sample et al. (1996) reported that scaling factors, such as used for mammals, are not appropriate for avian species because an analysis of existing data showed that the scaling factor which ranged from 0.63 to 1.55 with a mean of 1.15, was not significantly different than 1. This assumes that toxicity effects to birds of prey receptor species would be similar to the species tested (ring-necked pheasant for PCB) after adjusting for differences in food consumption rate and body weight of the receptor species. Therefore, based on the similarity of toxicity values reported among avian species, the NOAELs reported for the test species ($NOAEL_T$) were assumed to be equivalent to the NOAEL for herring gulls and cormorants (Equation [10], Sample et al. 1996).

Mammalian

$$EL_{Dolphin} = NOAEL_{mink}\left(\frac{bw_{mink}}{bw_{dolphin}}\right)^{1/4} \quad [9]$$

Avian

$$EL_{Gull} = EL_{Cormorant} = NOAEL_T \quad [10]$$

The dietary consumption benchmarks (D) of prey tissues for herring gull (D_{Gull}, Table 12), cormorant ($D_{Cormorant}$, Table 13), and dolphin ($D_{Dolphin}$, Table 14) were determined by the following relationships:

	D	=	TRV/*F* μg/g (wet weight)	[11]
where	TRV	=	($EL_T \times$ UF)	[12]
and	EL	=	Effect Level for receptor species (e.g. No Observed Adverse Effects Level – NOAEL)	
	UF	=	uncertainty factor	
	F	=	dietary uptake factor (g/g body weight/day)	
	F	=	*aRdL*	[13]
	a	=	assimilation efficiency = 0.9	
	R	=	food ingestion rate (g/g body weight/day)	
	R	=	*f*/*bw* g/g body weight/day (Sample et al. 1996)	[14]
	f	=	Food consumption rate: herring gull = 264 g/d for herring gulls (U.S. EPA 1995, CFR40 part132). cormorant = 475 g/d (Environment Canada 2004c). dolphin = 27,000 g/day (Davis and Schmidl 1997)	
	bw	=	herring gull body weight = 1,100 g (U.S. EPA 1995, CFR40 part132) cormorant body weight = 1,900 g (Environment Canada 2004c) dolphin body weight = 215,000 g (Seaworld 2000)	
	d	=	fraction of diet = 1.0	
	L	=	fraction of life span = 1.0	

Listed as a threatened species in the Southeastern US (NOAA 2004), mature loggerhead sea turtles (*Caretta caretta*) weigh about 113 kg (Bolten and Witherington 2003, Turtle Trax 2004) and can consume about 3% of their body weight per feeding (Seaworld, Ask Shamu, personal communication). Captive loggerhead turtles generally feed about three times a week, but some loggerheads (especially rescued animals) feed every day (Seaworld, Ask Shamu, personal communication). Assuming that loggerheads in the wild will feed about five times a week (especially if food is plentiful at a reef), the daily intake rate was estimated as 1450 g/day. Due to the lack of toxicity data on reptiles, the lowest TRVs obtained for cormorant or dolphin for PCBs was assumed to be protective of sea turtles. The benchmark was obtained by using the same scaling factors used for mammals (Equation [9]) and avians (Equation [10]) and substituting the body weight and ingestion rate of loggerhead turtles into Equation [13]. The dietary benchmarks for loggerhead sea turtle (D_{Turtle}) were set to the more conservative mammalian literature toxicity reference values (Table 15).

The top predators on the reef are sharks and barracudas that would be drawn to the abundance of food at the reef. Long-lived and carnivorous, sharks only consume about 1-10% percent of their total body weight per week (Seaworld 2004b, Pauley 1989). Sharks don't require as much energy as birds and mammals because they are cold-blooded and very efficient swimmers (Seaworld 2004b). A common large, up to 2.4 m (7.5 ft.), coastal shark in the waters of Southeastern US is the sandbar shark (*Carcharhinus plumbeus*). In the Florida east coast shark fishery between 1938 and 1950 sandbar sharks constituted about 50,000 of the 100,000 coastal sharks caught commercially (Jon Dodrill, Florida Fish and Wildlife, personal communication). A reef-associated predator, sandbar sharks feed primarily on boney fishes (>95%) but they will also consume other elasmobranches, cephalopods, and shrimps (Fishbase 2004a). Growing up to 45-90 kg (100 – 200 lbs) in weight (Knickle 2004), sandbar sharks occupy the upper trophic level of the reef food chain (Trophic Level 4.1 to 4.5, Fishbase 2004a). Another reef-associated top-level predator frequently observed foraging on artificial reefs is the great barracuda (*Sphyraena barracuda*) (Robert Turpin, Escambia County, FL, Marine Resources Division, personal communication). Smaller, 2 m (6.6 ft) total length and maximum weight 50.0 kg (110 lbs, Fishbase 2004b) but faster swimmers than sharks, barracuda probably require more energy needs (per unit body weight) than sharks. With their large mouths and very sharp teeth, barracuda feed on jacks, grunts, groupers, snappers, small tunas, mullets, killifishes, herrings, and anchovies, sometimes by chopping large fishes in half (FMNH 2004). An opportunistic predator, great barracuda feed throughout the water column and are located at a Trophic Level of 4.5 (Fishbase 2004b).

Toxicological benchmarks for PCBs in shark and barracuda were developed using the ratio of Food Chain Multipliers (FCMs) between trophic level IV (TL-IV reef predator, e.g. shark) and Trophic Level III (TL-III reef forager, e.g. prey) obtained from USEPA (2000b). The FCMs apply to chemicals with logKow values between 4.0 and 9.0 and "reflects a chemical's tendency to biomagnify in the aquatic food web" (U.S. EPA 2000b). FCM are used to account for the trophic transfer of a contaminant in the food chain. The ratio between FCM for TL-IV and TL-III gives the relative increase in contaminant concentrations between a shark and its prey, assuming all the shark's dietary requirements came from TL-III. The ratio was calculated by:

$$wFCM_{TotalPCB} = \Sigma(f_{PCBi} \times FCM4_i/FCM3_i) \quad [15]$$

where

$FCM4_i$ = The TL-IV FCM for homolog i (i=1, 10) (US EPA 2000).
$FCM3_i$ = The TL-III FCM for homolog i (i=1, 10) (US EPA 2000).
f_{PCBi} = The fraction of PCB present as homolog i (i=1, 10) in fish tissue (see Table 9)

This formulation is weighted by the fraction of PCBs observed in fish tissue for each homolog group (Table 9, Figure 12) and assumes that the shark and its prey have the same relative distribution of PCBs in their tissues. The benchmark tissue concentrations for PCB using the above ratio, were calculated by setting the shark's tissue concentration to the critical body residue NOED and LOED, and solving for the allowable tissue concentration in the diet of a shark or barracuda (D_{Shark}, Table 16):

$$D_{Shark} = NOED/wFCM_{TotalPCB} \qquad [16]$$

$$D_{Shark} = LOED/wFCM_{TotalPCB} \qquad [17]$$

The benchmarks obtained for avian consumers (Table 12, Table 13) indicated that cormorants and gulls would have about the same sensitivity to PCB exposure. The benchmarks for exposure to TotalPCB were 0.8 mg/Kg wet weight for the no effects level and 8.0 mg/Kg wet weight for the low effects level, reflecting the factor of ten difference assumed between the observed LOAEL and calculated NOAEL reported in Sample et al. (1996). The Total PCB benchmark was based on a 17-week chronic exposure to technical grade Aroclor 1254 introduced by gel capsules mixed into the ring-necked pheasants' food. The test showed significantly reduced egg hatchability following exposure throughout a critical life stage (reproduction, Dahlgren et al. 1972 cited in Sample et al. 1996), and these effects were assumed to be applicable and appropriate for the protection of sea birds. The main difference between the gull and cormorant benchmark was that invertebrate data could be evaluated using the benchmarks for herring gull, while the cormorant benchmarks were only applicable to the fish data.

The relative increased sensitivity of mammalian species to PCBs was evident in the fact that the dolphin NOAEL benchmark (0.32 mg/Kg wet weight) was about 3 times lower than the cormorant NOAEL benchmark (0.8 mg/Kg wet weight) and the dolphin LOAEL benchmark (1.58 mg/Kg wet weight) was 5 times lower than the cormorant LOAEL benchmark (8 mg/Kg wet weight). The Total PCB benchmarks for dolphins were based on a 4.5-month chronic study where mink were feed a diet mixed with varying concentrations of technical grade Aroclor 1254. The study found that prolonged exposure to PCBs in the mink's diet reduced the number of live kits born at the end of the reproductive cycle (Aulerich and Ringer 1977 cited in Sample et al. 1996). Enough treatment doses were tested to allow the NOAEL to be calculated rather than estimated as was done for the ring-necked pheasant study (Sample et al. 1996), which explains the reduced range between the NOAEL and LOAEL benchmarks for dolphins as compared to birds. The effects from PCBs observed in mink were assumed to be applicable and appropriate for the protection of dolphins. In a study of PCB risk to bottlenose dolphins (*Tursiops truncates*), Schwacke et al. (2002) justified the use of mink as surrogates for dolphins because mink are the most sensitive mammalian species for which PCB toxicity data are available and that mink have similar pharmokinetic pathways as dolphins (cetaceans), specifically, both have relatively lower levels of phenobarbital-type (PB-type) and 3-methylcholanthrene-type (MC-type) enzymes necessary for metabolizing PCBs than other birds or mammals. Additionally, it is very difficult to obtain toxicological data for a protected species such as dolphins (Schwacke et al. 2002).

The Total PCB fish tissue NOAEL benchmark for bottlenose dolphin (0.32 ug/g wet weight) is similar to the wildlife protection value (WV_{Fish}) derived to be protective of piscivorous birds and mammals (U.S. EPA 1997). The WV_{Fish} is based on monitoring data compiled in the

National Sediment Quality Survey; it is based on the sum of measured congeners (sumPCB, i.e. NOAA 18) and set to the lowest toxicity threshold calculated for kingfisher, herring gull, otter, mink or eagle (U.S. EPA 1997). The mammalian species are more sensitive to PCBs, so the WV_{Fish} value was set to the mammalian threshold. When the WV_{Fish} value of 0.16 mg/Kg wet weight sumPCB is expressed as tPCB using the empirical relationship[9] from the NOAA Status and Trends Program (NOAA 1991), the value of 0.352 mg/Kg wet weight is obtained, which is essentially the same as the dolphin benchmark.

Because applicable TRVs are currently not available for reptiles (Chris Salice, U.S. EPA, personal communication), the mammalian TRV for PCB was assumed to be protective of sea turtles after accounting for consumption rate and size of sea turtles. The sea turtle benchmarks for tPCB were based on mammalian (mink) TRVs (Table 15c). The massive size of sea turtles compared to sea birds accounts for the higher avian-based benchmarks for turtles and the relatively low feeding rate of cold-blooded sea turtles compared to warm-blooded mammals accounts for the higher mammalian-based benchmarks for turtles. It is assumed that warm-blooded birds and mammals are more sensitive to PCBs than sea turtles (and other reptiles), but, in fact, it is not known whether this is true or not.

The FCM used to calculate the shark/barracuda benchmark were based on the conceptualized food chain for the reef represented by phytoplankton and encrusting algae (TL-I), sessile filter feeder (TL-II), planktivore (TL-II), forager (TL-III), and predator (TL-IV) and that a steady state existed among PCB sources (PCB-containing materials) and PCBs in all the abiotic (sediment, pore water, water, suspended solids, dissolved organic carbon) and biological compartments. Assuming that the top trophic level predators (TL-IV shark/barracuda) feed 100% on fish (TL-III forager) the tissue concentrations of prey that would cause the critical body residue levels of shark/barracuda to exceed the NOED or LOED were calculated. The shark/barracuda NOED (2.52 mg/Kg wet weight) and LOED (4.066 mg/Kg wet weight) were about 8 and 2.5 times higher than the dolphin prey NOAEL and LOAEL benchmarks, respectively. The shark/barracuda benchmarks assumed that the large voracious predators had the same sensitivity to PCBs as striped bass (Westin et al. 1983) and winter flounder (Black et al. 1988) tested in the laboratory (Table 16).

5.2.4 Analysis of Dioxin-like Toxicity

Early toxicity studies on PCBs were conducted on technical Aroclors and effects were reported as a function of total PCB or total Aroclor concentrations. In the last decade, evidence has been mounting that specific congeners are more toxic than others, especially the dioxin-like coplanar PCBs – PCBs with zero or one chlorine atom in the ortho position (closest to the biphenyl double bond, see information on orientation [Polychlorinated Biphenyls (PCB) Multimedia Training Tool]) (Ahlborg et al. 1994, Van den Berg et al. 1998, Barney 2001). The

[9] The equation for total PCB (tPCB = 2.19sumPCB + 2.19) was obtained by NOAA's Status and Trends Program from a regression of empirical data from samples that were analyzed for both individual congeners (sumPCB) and total aroclors (tPCB) (NOAA 1991).

concentrations of these dioxin-like coplanar PCB congeners are expressed as the equivalent concentration of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), the most potent dioxin congener (Van den Berg et al. 1998), determined from the toxicity equivalent quotient (TEQ). The TEQ is calculated by summing the products of the concentrations of individual coplanar congeners [PCB_i] and their dioxin toxicity equivalency factors (TEF_i):

$$TEQ = \Sigma\, coPCB_i \times TEF_{ij} \qquad [18]$$

Where TEF_i expresses the potency of coplanar congener "i" to species "j" (fish, mammals, or birds) relative to TCDD (i.e., TCDD TEF=1). The World Health Organization (Van den Berg et al. 1998, EPA 1998) has established TEFs for fish, birds, and mammals that can be used in ecorisk assessments for the coplanar PCBs (Table 17, see TEF Table on U.S. EPA PCB web site).

As was explained above, the current version of PRAM only models the accumulation of PCB homologs not individual congeners however, leach rate data was collected on individual congeners, including the coplanar congeners (except for PCB081) during the leachrate experiments (Table 18, George et al. 2005). Assuming that individual coplanar congeners behave similarly to the homologs modeled in PRAM, the proportionality between the individual coplanar congener and corresponding homolog observed during the leachrate experiments (Table 19) was used to estimate the coplanar concentration present in the food chain modeled by PRAM:

$$coPCBi = ww\_HOMOCLj \times fh\_PCBi \times 10^6 \text{ [pg PCB/g WW]} \qquad [19]$$

$$coPCBLi = lipid\_HOMOCLj \times fh\_PCBi \times 10^6 \text{ [pg PCB/g Lipid]} \qquad [20]$$

Where fh_PCBi = The fraction of homolog "j" accounted for by coplanar congener "i" observed in the leachrate experiments on a wett weight basis (Table 19)

ww_HOMOCLj = The wet weight concentration of homolog "j" predicted by PRAM [mg/Kg WW]

lipid_HOMOCLj = The lipid weight concentration of homolog "j" predicted by PRAM [mg/Kg Lipid]

No data were available for PCB081, so concentration of 3,4,4',5-tetrachlorobiphenyl (PCB081e) was estimated using the concentration of 3,3',4,4'-tetrachlorobiphenyl (PCB077) and assuming that the concentration was proportional to the concentration reported for lake trout (Table 20, Cook et al. 2003) and pre- and postmigrating sockeye salmon (deBruyn et al. 2004).

$$PCB081e = R_{81:77} \times PCB077 \qquad [21]$$

where

$R_{81:77}$ = Average ratio of PCB081/PCB077 reported by Cook et al. (2003) and deBruyn et al. (2004)

The homolog concentrations for terta, penta, hexa, and heptachlorobiphenyl predicted by PRAM were multiplied by the proportionality factor (fh_PCBi) to obtain the concentration of coplanar congeners, which were then multiplied by the respective TEFs to calculate TEQs forfish eggs and to assess dietary exposure to birds and mammals. Eggs and sac fry larvae are the most susceptible life stage of fish to dioxin-like toxicity (deBruyn et al. 2004, Cook et al. 2003). Risk to fish from exposure to dioxin-like coplanar PCBs was evaluated by estimating the TEQ concentration that could be passed from female fish to eggs. Mortality to lake trout sac fry larvae has been reported at 30 pg TEQ/g egg (wet weight) and sublethal effects have been reported above 5 pg TEQ/g egg wet (Cook et al. 2003). Salmon eggs (rainbow trout) were found to be more sensitive with a no effect to egg mortality at 0.3 pg/g egg wet weight and low effect level of 3 pg/g egg lipid wet weight (deBruyn et al. 2004, see Table 10 and Table 11). Assuming that the coplanar concentrations obtained for fish species from PRAM represented tissue residues in female fish, the TEQ concentrations in eggs were estimated using the average egg to female transfer ratio for each coplanar congener (EF_{PCBi}) calculated from data for lake trout and pre- and postmigrating sockeye salmon eggs and females reported in Cook et al. (2003) and deBruyn et al. (2004, Table 20). The fish egg TEQ was obtained by:

$$TEQ\_eggL = \Sigma\ coPCBLi \times EF_{PCBi} \times TEFi(fish)\ \text{[pg TEQ/g egg lipid]} \quad [22]$$

$$TEQ\_eggW = TEQ\_eggL \times f\_eggLIPIDw\ \text{[pg TEQ/g egg wet weight]} \quad [23]$$

where

$f\_eggLIPIDw$ = = 0.1091 the average mass fraction of lipid:wet weight in eggs (roe) reported from literature (see Table 20C)

$$EF_{PCBi} = \frac{\text{[PCBi] pg/ g lipid egg tissue}}{\text{[PCBi] pg/ g lipid female muscle tissue}} \quad [24]$$

$TEF_{PCBi(Fish)}$ = Fish dioxin TEF for coplanar congener “i”

The TEQs for dietary exposure were calculated to assess the risk of dioxin-like exposure to fish eating birds and mammals (see Table 12, Table 13, and Table 14).

$$TEQB = \Sigma\ [coPCBi] \times TEF_{PCBi(Bird)}\ \text{[pg TEQ/g ww]} \quad [25]$$

$TEF_{PCBi(Bird)}$ = Avian dioxin TEF for coplanar congener i

and

$$TEQM = \Sigma\ [coPCBi] \times TEF_{PCBi(Mammal)}\ \text{[pg TEQ/g ww]} \quad [26]$$

$TEF_{PCBi(Mammal)}$ = Mammalian dioxin TEF for coplanar congener i

The predicted concentrations of TEQs in fish eggs, bird prey, and mammal prey were compared to fish egg (Table 10 and Table 11), avian (Table 12 and Table 13), and mammalian (Table 14) TEQ benchmarks.

5.3 Ecorisk Analysis

The ecological effects benchmarks (Table 6) represent the thresholds, that if exceeded would raise “sufficient concern regarding adverse ecological effects” (U.S. EPA 1996a). These data were used to assess potential ecorisks to the assessment endpoints associated with the artificial reef (Table 3). Assessment endpoints include sediment and water exposure modeled by TDM, components of the food chain modeled by PRAM, as well as reef and avian consumers not directly modeled by PRAM. Risks from sediment and water exposures modeled by TDM and PRAM were also evaluated by comparing the predicted concentrations to the sediment and water benchmarks. Risks to assessment endpoints modeled in the PRAM food chain were evaluated by comparison to benchmarks protective of tissue residue exposures. Risks to reef and avian consumers were evaluated by benchmarks protective of dietary exposure.

The risk analysis consisted of two components: a graphical analysis and a hazard quotient analysis. The data predicted by the TDM/PRAM models were plotted as time series from 0 – 730 days following sinking to represent the transient release period followed by the steady state condition predicted by PRAM (plotted as "Day 800"). Simulated data for water, sediment, and tissue residues for the pelagic, benthic, and reef communities were plotted on the time series plots along with the respective benchmarks (if the benchmarks fell within the scale of the data plotted). The average and min to max range of PCB concentrations obtained from the EMAP and IMAP data were also plotted on the plots of tissue residues to compare modeled data to regional and background concentrations.

To quantify the potential for ecological risk, an ecological hazard quotient (HQ) was calculated for each receptor in a given exposure pathway, where the HQ is the ratio between the potential exposure level (concentration or dose *C*) and the ecological effects benchmark (B):

$$HQ_G = C / B \qquad [27]$$

Where *C* is the exposure concentration predicted using the models and B is benchmark concentration that, when exceeded, have been associated with causing ecological effects (i.e. values in Table 6). When HQ < 1 the chemical is below potentially harmful exposure levels and the HQ represents the fraction of harmful exposure. When HQ ≥ 1 the chemical is above potentially harmful exposure levels and the HQ represents the factor above harmful exposure.

5.4 Evaluation Criteria

The following evaluation criteria were used to evaluate the results of the ecorisk analysis. Short-term ecological risks (0 –2 years) were evaluated using the data obtained from the TDM coupled to PRAM. The long-term ecorisk (steady state) was evaluated using the results of PRAM under steady state conditions. The HQs from the time dynamic and steady state model results were evaluated for both the conservative and less conservative benchmarks for each applicable exposure pathway and assessment endpoint (Table 21). The HQs used in the evaluation were the highest HQ obtained from the time dynamic (TDM) or steady state (PRAM) model simulation. The conclusions were based on the evidence of potential ecological harm.

The HQ evaluation criteria are listed below:

Outcome	Interpretation	Risk Conclusion
HQ < 0.1	Extremely unlikely exposure is harmful	Negligible
0.1 ≥ HQ < 0.5	Very unlikely exposure is harmful	Very Low
0.5 ≥ HQ < 1.0	Unlikely exposure is harmful	Low
1.0 ≥ HQ < 5.0	Moderate likelihood that exposure is harmful	Medium
5.0 ≥ HQ < 10.0	Likely that exposure is harmful	High
HQ > 10	Very likely that exposure is harmful	Very High

The overall risk was determined by the combination of risk levels obtained for exceeding the conservative (e.g. NOAEL) and less conservative (e.g. LOAEL) benchmarks for each assessment endpoint evaluated

Risk of Exceeding Conservative Benchmark	Risk of Exceeding Less Conservative Benchmark	Overall Risk
Negligible	Negligible	Negligible
Very Low	Negligible	Negligible
Low	Negligible	Negligible
Medium	Negligible	Very Low
High	Negligible	Very Low
Very High	Negligible	Very Low
Very Low	Very Low	Very Low
Low	Very Low	Very Low
Medium	Very Low	Low
High	Very Low	Low
Very High	Very Low	Low
Low	Low	Low
Medium	Low	Low
High	Low	Low
Very High	Low	Medium
Medium	Medium	Medium
High	Medium	Medium
Very High	Medium	High
High	High	High
Very High	High	Very High
Very High	Very High	Very High

Photo by Keith Mille (keith.mille@MyFWC.com) Florida Fish & Wildlife Conservation

6. Results and Discussion

6.1 Model Evaluation

The output from the TDM and PRAM models were evaluated to the extent possible to identify any biases and verify the reliability of the results. Because the models are simulating future conditions, no field data are readily available to validate the model output. However model performance was evaluated to assure that the model results are internally consistent (the same set of inputs gives the same set of results), that the predictions of the model conform with the physiochemical properties being modeled, and that results produced by the model were consistent with similar studies reported in the literature.

The main quality control check on the TDM model was to assure that mass balance was accounted for within the model. Subroutines were incorporated into the model to check for conservation of mass and the simulation results were evaluated to determine whether the results were reasonable approximations of natural phenomena. Additionally, Dr. Keith Little (RTI, International, Research Triangle Park, NC) conducted a detailed third party peer review of the model code and output to assure that model structure, algorithms, kinetics, and simulated output conformed to accepted conventions and standards with satisfactory results (Dr. Keith Little, RTI, International, personal communication). Dr. Little also performed a similar review of PRAM 1.4, which also met with satisfactory results (Dr. Keith Little, RTI, International, personal communication).

The PRAM output was compared to literature values to evaluate the validity and accuracy of the biological uptake and trophic transfer algorithms. The results of this evaluation are provided below.

6.1.1 Zone of Influence

Initial runs using PRAM 1.4C were conducted to verify model stability and accuracy by assuring that the model provided the same set of results for the same set of inputs and verifying that the model was functioning properly. A series of PRAM runs were conducted by keeping all parameters constant using the default values and varying the ZOI parameter from 1, 2, 3, 4, 5, and 10 (see Appendix B PRAM Output for Varying ZOI). Changing the ZOI only changes the physical dimensions of the model – the volume of air, water, and sediment included in the model (Figure 13) – all the physical, chemical, and bioenergetic equations and food chain linkages remain the same. Only the volume of water in the vessel's interior remains constant at 5.38×10^4 m^3 (14,214,003 gallons). The ZOI represents a column of water directly around the ship. At ZOI=1 the water column boundary is defined by the hull of the ship, there is no sediment compartment,[10] the lower water column is the water surrounding the ship which extends up to the pycnocline and is about 3 times larger (range 2.87 to 3.29 for ZOI=1 to 10) than the upper water column and about 4.5 times larger (range 4.31 to 4.83 for ZOI=1 to 10) than the overlying air compartment. The interior of the vessel was interpreted as the interior compartments of ship (Figure 8), the spaces separated from the water column by bulkheads, passageways, and hatches. The hangar-deck and other spaces that are open to ocean currents were considered to be the exterior of the ship. These are the primary surfaces that will be used as substrate by colonizing reef organisms where they will be exposed to PCB concentrations in the lower water column.

For purposes of evaluating ecological effects from water column exposure the bulk water concentration (C_{BW}) was calculated as:

$$C_{BW} = C_{W\_FD} + TSS \times C_{TSS} + DOC \times C_{DOC} \text{ [mg/L]} \qquad [28]$$

where

C_{W_FD} = Freely dissolved concentration in water [mg/L]
C_{TSS} = Concentration in suspended sediments [mg/Kg]
C_{DOC} = Concentration in dissolved organic carbon [mg/Kg]
TSS = The amount of suspended sediment = 10 [mg/L]
DOC = The amount of dissolved organic matter = 0.6 [mg/L]

Based on the default inputs for PRAM (Appendix B.2 PRAM Default Parameters (ZOI =2)) changing the ZOI from 1 to 10 resulted in about a 40% to 75% decrease in the concentration of the lower water column and pore water, a 10% to 20% decrease in the upper water column concentration, and the interior vessel water concentration remained constant at 6.7×10^{-4} mg/L (Figure 14). The interior vessel water was about 2-3 orders of magnitude higher than the concentration of the lower water column, 5 orders of magnitude higher than the concentrations in sediment pore water, and 6 orders of magnitude higher than the concentrations predicted for the upper water column.

Total PCB concentrations in the sediment also decreased 40-80% as a function of ZOI, with the greatest decrease occurring between ZOI=1 and ZOI=2 when the sediment bed is added to the model (Figure 15, NEHC/SSC-SD 2005a). Slight increases in the concentration of Total PCB in the air compartment were modeled as a function of ZOI (Figure 16). This was probably due to the effect of increasing the boundary between air and water, which resulted in a increase in the mass transfer of PCBs between the upper water column and the overlying air as the ZOI was increased.

The change in concentration of Total PCB modeled by PRAM in food chains of the pelagic, benthic, and reef communities as a function of changes in the ZOI is shown in Figure 17 and summarized in Table 22. The concentration of Total PCB modeled in the pelagic and benthic food chains decreased in proportion to the 40-75% reduction observed for the lower water column and pore water concentrations. However, the upper trophic levels of the reef community

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[10] Although the sediment compartment is undefined for ZOI=1 PRAM still provides results for sediment and porewater concentrations, so it was assumed that this represented sediments “very “close to the ship, e.g. ≤ 15 m from the ship, such as sediment that could accumulate on the flight or hanger decks.

remained relatively constant, decreasing by less than 2-4% over the range of ZOIs used. This is because the accumulation of PCBs in the reef community is controlled by exposure to interior vessel water that does not change as a function of ZOI.

6.1.2 Bioaccumulation Factor

The lipid-based bioaccumulation factor (BAF) is defined as the lipid based concentration of a -chemical (C_{Lipid}) in a organism divided by the freely dissolved concentration in the water (C_{W_FD}):

$$BAF = C_{Lipid} / C_{W\_FD} \quad [29]$$

The BAF represents the amount of chemical bioaccumulated from exposure to water and food (Fisk et al. 1998, 2001). In PRAM the BAF is calculated using the weighted average of the steady state water concentration in each compartment of the model that the organism is exposed to (interior water, lower water column, upper water column, and pore water, NEHC/SSC-SD 2005a, p2-84). Since changing the ZOI only affects the physical dimensions of the model, varying the ZOI has the effect of reduce the steady concentrations of the abiotic compartments because the PCB emission rate is held constant (NEHC/SSC-SD 2005a, p2-10). Therefore, changing the ZOI should not appreciably the BAFs predicted by the model.

The BAF obtained from PRAM with a ZOI=1 for the components of the pelagic, benthic, and reef communities as a function of Log(K_{ow}) are shown in Figure 18. The BAFs followed the generally expected behavior of higher bioaccumulation of homologs with a Kow > 4.7. The primary producers (phytoplankton and algae) had a constant BAF for the di- to decachloro-biphenyls reflecting the fact that a constant BCF was used for the homologs with Kow > 5.0, as is recommended in the literature (Spacie et al. 1995, Connolly 1991, NEHC/SSC-SD 2005a, p2-82). The highest BAFs were calculated for jack, herring, crab, and grouper, while lower BAFs were obtained for the benthic community, zooplankton from the pelagic community, and urchin and triggerfish from the reef community. The BAFs calculated for bivalves followed a different pattern than the other species, the bivalve BAFs were relatively constant for the homologs modeled. Only slight changes in the modeled BAFs were detected over the range of ZOI=1 to 10 (Figure 19, Table 23).

6.1.3 Predicting PCB bioaccumulation

The accuracy of PRAM to predict bioaccumulation between trophic levels was evaluated by comparing data reported in the literature on PCB bioaccumulation as a function of diet to predictions obtained from PRAM. The important aspect of this evaluation is not necessarily to reproduce the predicted concentrations, but to evaluate whether the general pattern (increasing bioaccumulation as a function of Kow), degree of biomagnification between trophic levels, and relative magnitude of the accumulation is in agreement with literature data. In a study on the bioaccumulation of PCBs in the top predators (Chinook and Coho salmon) of the food chain in tributaries to Lake Michigan, Jackson et. al (2001) reported statistically significant regressions that predicted PCB homolog levels in salmon (TL4) as a function of tissue concentrations in pelagic mysids (*Mysis relicta*) and benthic amphipods (*Diporeia* spp.), which occupied TL2 in the limnetic food chain.

$$C_{Salmon(i)} = \mathbf{m_i}(C_{Prey(i)}) + \mathbf{b_i} \quad [30]$$

where

$C_{Salmon(i)}$ = Concentration of homolog(i) in Coho or Chinook salmon

$C_{Prey(i)}$ PCB concentration of homolog(i) in mysid or amphipod

$\mathbf{m_i}$ = Slope for homolog(i)

$\mathbf{b_i}$ = Intercept for homolog(i)

The food chain studied by Jackson et al. (2001) was very similar to the pelagic and benthic communities modeled by PRAM and there was a high degree of correlation between the TL2 macroinvertebrates and the TL3 salmon because the macroinvertebrates were the main route of transfer in the pelagic (mysid) and benthic (amphipod) food webs in the lake. Using the concentrations predicted by PRAM for TL2 pelagic (zooplankton) and benthic (infauna) prey the regressions were used to predict the PCB concentrations in the TL4 pelagic (jack) and benthic (flounder) and compared to the TL4 concentrations modeled by PRAM. When both the slope and intercept of the regression were used the results showed a similar pattern, but the PRAM predictions were less than what was obtained using the regressions, with a greater difference for the pelagic food chain than for the benthic food web (Figure 20). A similar pattern was found for the predicted Total PCB concentrations, PRAM under predicted bioaccumulation in the pelagic food chain was within the range obtained for the benthic food chain Figure 21. Note, that the Coho and Chinook concentrations for the benthic community and Chinook concentration for the lower chlorinated homologs could not be predicted, because the prey concentration were too low and the regression with intercept resulted in a negative value. This probably occurred because the modeled concentrations were outside (lower) than the empirical data used to calculate the regression. However, when PCB homologs were predicted using just the slope from the regression a much better agreement was obtained between PRAM and the regression results for both the pelagic and benthic communities for homologs (Figure 22) and Total PCB (Figure 23).

These predictions are based on the assumption that the Lake Michigan food chains are similar to the pelagic and benthic food chains modeled in PRAM, which is a fairly reasonable assumption given that the food chain studied by Jackson et al. (2001) was relatively simple and that the primary route of exposure was through the diet. Jackson et al. (2001) reported that the diet of secondary consumers (alewife and scorpin fish, for pelagic and benthic food chains, repectively) was made up of “almost pure” mysids and amphipods leaving little doubt about the route of PCB transfer in the food chain to the tertiary consumers (salmon). It is reasonable to compare the PRAM output with the values obtained using just the slope of the uptake regressions, because the intercept is very site-specific and affected by factors like analytical detection limits, analytical and sampling biases, and differences in contaminant residues in wild fish due differences in gender, age, size, health, and other geographic variations in the sample population (Johnston et al. 2002). Although there are undoubtedly differences in the source signatures of PCBs present in Lake Michigan compared to the source of PCBs in PRAM, the sources are probably all derived from Aroclor mixtures and any PCBs released would be subjected to the same physical, chemical, and biological processes that are modeled in PRAM. The good agreement between the PRAM predictions and the uptake regressions shows that PRAM is providing reasonable estimates for this aspect of the model.

6.1.4 Biomagnification between trophic levels

Another means of evaluating the output from PRAM is to compare the relative increase in bioaccumulation as a function of the links in the food chain or trophic level (Stapleton et al 2001, Fisk et al. 2001). This approach evaluates the biomagnification (BMF) factor, or step increase in PCB accumulation moving from one trophic level to the next, by comparing the relative increases in PCBs between predator and prey modeled by PRAM to data reported in the literature.

The lipid-based, trophic level corrected BMF_{TLC} is calculated by the ratio of the lipid-based tissue concentration of the predator (C_{PRED_L}) to its prey (C_{PREY_L}) normalized to the TL of each organism (Fisk et al. 2001):

$$BMF_{TLC} = \frac{C_{PRED\_L} / C_{PREY\_L}}{TL_{PRED} / TL_{PREY}} \qquad [31]$$

The TL for the PRAM food chain was calculated based on the weighted average of each component of a organism's diet:

$$TL_{(j)} = 1 + \Sigma\, f_{diet(i)} \times TL_{Prey(i)} \qquad [32]$$

where

$TL_{(j)}$ = Trophic level for species (j), summed for number of (i) prey items modeled

$f_{diet(i)}$ = Fraction of diet for prey item (i)

$TL_{Prey(i)}$ Trophic level of prey item (i)

The default dietary preferences used by PRAM and the TL determined by diet for each compartment modeled in the food chain is shown in Table 24. For the calculations it was assumed that algae and plankton were assigned a TL of 1, and suspended sediments in the upper water column, suspended sediment in the lower water column, and sediment were assigned a TL of 1.125, 1.250, and 1.5, respectively, to represent the relative increase in recycled detrital matter in the sediment pool.

Stapleton et al. (2001) reported Total PCB concentrations in the pelagic, benthic, and demersal food chains in Grand Traverse Bay Lake Michigan for which BMF_{TLC}'s were calculated. Fisk et al (2001) reported BMF_{TLC}'s for PCB congeners in a demersal food chain from Arctic waters of the Northwater Polynya near northern Greenland, and Mackintosk et al. (2004) reported data on the accumulation of six PCB congeners in a coastal marine food web in False Creek Harbor, Vancouver, BC, Canada. These studies provide data on the bioaccumulation of Total PCBs and specific congeners from a wide range of ecosystems for comparison to PRAM.

The following food chains were evaluated:

Food Chain	TL2	TL3	TL4
Grand Traverse Bay			
Pelagic	Zooplankton →	Alewife →	Lake Trout
Benthic	Amphipod →	Sculpin →	Salmon
Demersal	Mysid →	Bloater →	Burbot
Northwater Polynya			
Demersal	Copepods →	Amphipod →	Arctic Cod
False Creek Harbor			
Pelagic	Juvenile Perch →	Greenling →	Dogfish
Benthic	Clams →	English Sole →	Dogfish
Demersal	Juvenile Perch →	Staghorn Sculpin →	Dogfish

The BMF_{TLC} obtained for the predictions from PRAM compared very well to the literature values from the studies cited above (Figure 24, Table 25). This analysis assumed that the food chain links evaluated were similar and subject to the same physical and chemical processes modeled in PRAM. Although there is uncertainty associated with the trophic level assignments reported in the literature studies, the TL assignments were all based on measurements of δN^{13} and δC^{13} isotopes. In calculating the BMF_{TLC}'s it was assumed that 100% of the diet came from the prey species being evaluated, which actually varied in PRAM as it does in natural food webs. The analysis provides a way to independently evaluate model performance by comparing the relative increases in PCB accumulation along specific links of the food chain. Another source of uncertainty is that the PCB concentrations from the literature were reported as sums of congeners (Stapleton et al. 2001, Fisk et al. 2001) or individual PCBs (Mackintosh et al. 2001) and the PRAM output was evaluated as the sum of homologs (Total PCB). More detailed evaluations could be performed for individual homologs and groups of congeners to further evaluate the model. Based on the current analysis it appears that the predictions from PRAM agree with the expected BMFs of PCBs in similar food chains.

6.1.5 Trophic level and Bioaccumulation Factors

The relationship between trophic level and BAFs was evaluated by comparing measured BAFs reported by Burkhard et al. (2003, Figure 25) to the BAFs predicted by PRAM as a function of Kow (Figure 26). The comparison of the lipid-based bioaccumulation factors (BAFs) predicted by PRAM and BAFs reported for 13 species of fish from Green Bay Lake Michigan, the Hudson River, and Lake Ontario generally showed good agreement, although there appeared to be less PCBs accumulated for homologs between Log(Kow) 6 and 7, the penta- and hexachlorobiphenyls. The fact that PRAM showed the general trend of increasing BAFs as a function of Log(Kow) that tracks the literature values is very encouraging. The deviation from literature values for some of the TL3 (triggerfish) and TL4 (flounder and grouper) indicates that some model tuning may be warranted. The invertebrate predators were included on the plot for comparison purposes; comparable data on the BAFs in upper trophic level invertebrates are currently not available. Data for the higher chlorinated congeners and homologs with Log(Kow) > 7 were also not available. The BAFs for hepta- to decachlorobiphenyls would probably begin to decline as was indicated by the PRAM results.

There are many reasons for variability in BAFs obtained from field data, these include differences in the actual trophic level and the nominal or measured (with δN^{13} and δC^{13} isotopes), the fact that most ecosystems are in disequilibrium with chemical inputs and losses, errors and biases in sampling and analytical chemistry, and difference in age, size, gender, growth rate, and reproductive status of the specimens sampled (Burkhard et al. 2003, Johnston et al. 2002).

6.1.6 Food Web Magnification Factors

Perhaps the best way of evaluating the PRAM output is to look at bioaccumulation across the food web as a whole by calculating the Food Web Magnification Factor (FWMF, Fisk et al. 2001):

$$\text{FWMF} = e^{b} \qquad [33]$$

Where b is the slope of the log-linear (natural log) regression between PCB concentration and TL:

$$\text{Ln(PCB)} = a + b(\text{TL}) \qquad [34]$$

The regression takes into account bioaccumulation within the food web as a whole and b represents the rate of PCB accumulation as a chemical (in this case PCBs) moves up the food chain. When FWMF > 1 it means that the chemical is biomagnifing; FWMF < 1 indicates trophic dilution (Fisk et al. 2001, Mackintosh et al. 2004).

The FWMF for the pelagic, benthic, and reef food chains modeled by PRAM were calculated with the default PRAM output (ZOI=2) by regressing the Ln(PCB) for each homolog against the TLs calculated for the pelagic, benthic, and reef communities to obtain the regression coefficient (b) for each of the homologs (Figure 27, Figure 28, Figure 29, and Table 26). The resulting FWMFs from PRAM were compared to FWMFs reported for the Northwater Polynya Arctic Food Web (Fisk et al. 2001), the False Creek Harbor food web (Mackintosh et al. 2004), and a marine food web from Bohai Bay, China (Won et al. 2005, Figure 30).

The highest FWMFs obtained from PRAM were for the hexa-, hepta-, and nonachlorobiphenyls in the reef and pelagic communities. The homologs with Log(Kow) < 5.6 did not biomagnify in any of the communities and decachlorobiphenyl did not biomagnify in the benthic food web. There was very good agreement between the FWMF predicted by PRAM and the literature values. The PRAM results encompassed the range of FWMFs reported in the literature with the reef community having the highest FWMFs. Once again, the PRAM results follow the general trend observed in the literature data. There is quite a bit of scatter in the literature data, because values were calculated for individual congeners (including coplanar and non-coplanar PCBs) within greatly varying food webs. The Arctic food web encompassed a wide range of predator-prey interactions including sea birds and mammals (Fisk et al. 2001), while the marine food webs from Canada and China had similar structure at the lower TL they supported different top-level predators (Mackintosh et al. 2004, Won et al. 2005).

6.1.7 Summary of Model Evaluations

These results add to the confidence that PRAM is able to model food chain bioaccumulation of PCBs with reasonable accuracy. The model validation analysis described above for PRAM only evaluated the trophic transfer mechanisms in the model, which are independent of the input conditions (PCB releases rates) and transport processes also simulated in the model. Although some fine-tuning of certain aspects of the model may be desirable, the good agreement with literature values indicates that the results from PRAM are plausible and reasonably good estimates of what would occur given that the other model assumptions and procedures are accurate representations of what is occurring at the site.

6.2 Risk from Water Exposure

Time series of Total PCB concentrations predicted by the TDM for bulk water concentrations in the upper water column, lower water column, and sediment pore water within 15 m of the ship for the first two years following sinking and the steady state concentrations predicted by PRAM with a ZOI=1 and the water quality benchmarks are shown in Figure 31. Due to the partitioning of PCBs between freely dissolved, TTS, and DOC fractions simulated in the TDM and PRAM models, the TTS and DOC fractions accounted for 71.1%, and 28.4 % of the mass of PCBs in the bulk water. The freely dissolved fraction accounted for less than 0.5% of the mass of PCBs present in the lower and upper water columns. Predicted concentrations were well below the water quality benchmarks for both the short-term (TDM pulse) and long-term (steady state) exposure periods, and resulted in HQs < 0.1 during both exposure scenarios (see Appendix C. Tissue Concentrations and Hazard Quotients Calculated for Short-term and Long-term Ecological Risks). The interior vessel water concentrations were about 3 orders of magnitude higher the lower water column concentrations and were higher than the chronic and wildlife water quality benchmarks, but the concentrations did not exceed acute water quality criteria for PCBs (Figure 32).

Similar results were obtained for water column exposure predicted for short-term and long term exposures modeled for 15 m (ZOI=2, 15 m) and 30 m (ZOI=3, 27 m) from the ship (see Figure 33). The HQs calculated for these exposure levels were all well below HQ < 0.1 (data not shown). As was noted previously, the interior vessel water concentration did not change as function of ZOI, it remained constant at 6.9×10^{-4} mg/L. While the interior water concentrations remained well above chronic water quality benchmarks, the risk of exposure from the interior water and release of PCBs from the solid materials left on the ship were evaluated by the impact on exposure levels in the lower water column, upper water column, sediment, and the accumulation of PCBs in the biota living at the reef.

Based on the data available for evaluating water column exposures to reef organisms, the risk of exposure from PCBs in the lower water column, upper water column, and sediment pore water to ecological receptors at the reef is negligible.

6.3 Risk from Sediment Exposure

Time series of Total PCB concentrations predicted by the TDM for sediment within 15 m of the ship for the first two years following sinking and the steady state concentrations predicted by PRAM with a ZOI=1 (0 m) and the State of Florida sediment quality benchmarks are shown in Figure 34. Predicted concentrations were well below the sediment quality benchmarks for both the short-term and long-term exposure periods, and resulted in HQs < 0.1 for both the short-term and long-term steady state exposure scenarios (see Appendix C. Tissue Concentrations and Hazard Quotients Calculated for Short-term and Long-term Ecological Risks).

Similar results were obtained for sediment exposure predicted for short-term and long-term exposures modeled for 15 m (ZOI=2, 15 m) and 30 m (ZOI=2, 27 m) from the ship (see Figure 33). The HQs calculated for these exposure levels were all well below HQ < 0.1 (data not shown).

Based on the data available for evaluating sediment exposures to reef organisms, the risk of exposure from PCBs in sediment to ecological receptors on the reef is negligible.

6.4 Risk from Tissue Residue Exposure

The outputs of the TDM-PRAM were used to evaluate short-term (0 – 2 years) risks for communities within 15 m, 45 m, and 60 m of the vessel and the steady-predictions obtained from PRAM with a ZOI=1 (0 m), ZOI=2 (15 m), and ZOI=3 (27 m) were used to evaluate long-term ecological risks. The modeled concentrations were compared to the ecorisk benchmarks to evaluate potentially harmful exposures to PCBs. The tissue residues predicted in reef biota were compared to the TSV and B_{CV} benchmarks to evaluate potential bioaccumulation effects to residents of the reef. The tissue residues predicted for primary consumers, secondary consumers, and tertiary consumers were compared to the NOED and LOED benchmarks protective of critical body residues for PCBs.

Dietary exposure of Total PCB to reef and avian consumers was evaluated by comparing predicted prey concentrations to the dietary NOAEL and LOAEL benchmarks derived for herring gulls, cormorants, sea turtles, dolphins, and sharks/barracudas.

Estimates of TEQ exposure were obtained by assuming that dioxin-like coplanar congeners would be present in same congener:homolog proportion observed in the leachrate experiments (Table 19, George et al. 2005). Potential risks from dietary exposure of TEQs to gulls, cormorants and dolphins were evaluated by comparing modeled tissue concentrations in prey to TEQ dietary benchmarks for those species. Potential risks of TEQ exposure to fish eggs and sac-fry larvae, the most sensitive life stage of fishes to TEQ toxicity, were evaluated by predicting the maternal transfer of TEQs to fish eggs and comparing the resulting fish egg concentrations to sensitive egg residue benchmarks for TEQ exposure.

6.4.1 Exposure to Total PCB

6.4.1.1 Modeled Concentrations

The time series of Total PCB concentrations predicted by PRAM for the Pelagic Community within 15m of the reef for the first two years following sinking and the steady state concentrations with a ZOI=1 are shown in Figure 36. The EMAP data for Atlantic croaker (white symbols) and spot (yellow symbols) are average (min and max) for all data from the Louisianan Province (LP, diamond), Gulf Coast of Florida (LP-FLA large square), and Carolinian Province (CP, circles). The IMAP data are for three samples of sea trout, spot, and sea pig collected offshore from Pensacola (small squares). The dietary NOAEL for dolphin consumption of prey is also shown. The modeled tissue residues for Total PCB in the pelagic community showed that the top-level predators, jack (1.0×10^{-3} mg/Kg WW) and herring (0.6×10^{-3} mg/Kg WW) had about an order of magnitude higher PCBs than zooplankton (1.0×10^{-4} mg/Kg WW) and seven orders of magnitude higher than phytoplankton (2.0×10^{-12} mg/Kg WW), reflecting the biomagnification expected for PCBs. The highest concentrations were predicted from the steady state condition modeled by PRAM (ZOI=1) which were well below the background concentrations of PCBs reported from EMAP and IMAP and well below the ecorisk benchmarks protective of the pelagic community and reef and avian consumers (Appendix 3.1).

The models predicted similar tissue concentrations for the benthic community (Figure 36, Appendix 3.1). The highest concentrations were obtained from the steady state condition predicted by PRAM with ZOI=1. The top predator for the benthic community, flounder (1.2×10^{-3} mg/Kg WW), had the highest concentrations of PCBs followed by lobster (3.5×10^{-4} mg/Kg WW), epifauna (1.5 × 10-4 mg/Kg WW), and infauna (5.5×10^{-5} mg/Kg WW). The tissue concentrations predicted for the benthic community within 15 m of the ship were also well below background levels and ecorisk benchmarks.

The predicted tissue concentrations for the reef community are shown in Figure 37 and tabulated in Appendix 3.1. The time dynamic pulse showed a peak in tissue concentrations at one year for TL3 and TL4 predators, but the highest concentrations were predicted for the steady state condition (PRAM with a ZOI=1). The predicted concentrations for the upper trophic level species were within the range of background concentrations reported from the EMAP and IMAP data. The highest concentrations were predicted for grouper (1.2×10^{-1} mg/Kg WW), triggerfish (6.7×10^{-2} mg/Kg WW), crab (3.7×10^{-2} mg/Kg WW), and urchin (1.7×10^{-2} mg/Kg WW). The maximum tissue concentrations predicted for grouper, triggerfish, crab, and urchin exceeded the average concentrations reported for Atlantic croaker from LP, but the modeled concentrations did not exceed the maximum PCB level reported for LP. Only the concentrations predicted for grouper exceeded the maximum PCB concentrations reported for LP-FLA (Table 1). The tissue concentrations predicted for the reef community within 15 m from the hull were all below the ecorisk benchmarks.

Tissue residues for the pelagic community predicted by PRAM based on TDM output for 15 m and 45 m from the ship and steady state concentrations predicted by PRAM with a ZOI=1 and ZOI=2 showed very similar results for the pelagic (Figure 39), benthic (Figure 40), and reef communities (Figure 41). Concentrations predicted for the community within 45 m of the ship were very similar to the concentrations predicted for the community within 15 m of the ship (Appendix 3.1, 3.2). Likewise, concentrations predicted for the community within 65 m of the ship also changed very little (Appendix 3.3). The highest changes in PCB concentrations were in the predictions for the steady state conditions (see Figure 17).

6.4.1.2 Hazard Quotients for Total PCB

Potential effects from bioaccumulation were evaluated by calculating the HQs for TSV and B_{CV} (Figure 41). The HQs obtained for TSV and B_{CV} were all below HQ = 0.10, except for the TSV HQ calculated for grouper (HQ = 0.26) and triggerfish (HQ = 0.15) suggesting extremely to very low likelihood that the modeled exposures would be harmful.

Effects from exceeding critical body residues of Total PCBs in fish and invertebrates were evaluated by calculating the HQs for NOED and LOED (Figure 42). The HQ for critical body residues were all below HQ = 0.1 suggesting that it is extremely unlikely that the modeled exposures would be harmful to primary, secondary, and tertiary consumers at the reef.

Effects from dietary exposure to dolphins, cormorants, herring gulls, sea turtles, and sharks/barracudas were evaluated by calculating the HQs for NOAEL (Figure 43) and LOAEL (Figure 44). The HQs for the dolphin NOEAL exceeded 0.1 for consumption of crab, triggerfish, and grouper, the HQs for cormorant and herring gull exceeding 0.1 for consumption of grouper, and the HQs for sea turtle and shark/barracuda were < 0.1 for all prey items. The HQs for the dietary LOEALs were < 0.1 for all species and prey (Figure 44). The low HQs obtained for dietary exposure suggests extremely low to very low likelihood that the modeled tissue residues would be harmful to reef consumers.

Based on the data available for evaluating tissue exposures to reef organisms, the risk of exposure from Total PCB in tissues of organisms associated with the reef and in the diet of reef consumers is negligible Table 27.

6.4.1.3 Uncertainty

The estimates of tissue residues in the reef community are based on conservative estimates of PCB biogeochemical behavior in aquatic systems as applied within the development of PRAM (NEHC/SSC-SD 2005a) and the TDM (NEHC/SSC-SD 2005b) models. The model outputs were assumed to be valid representations of future conditions and, based on the criteria used to evaluate model performance (see Section 6.1 Model Evaluation) it appears that the models produced plausible and realistic results. The models are abstractions of real processes so there are uncertainties associated with the assumptions and mathematical procedures used in the models. In addition to strengths and weaknesses of PRAM (see Section 2.4, p2-25 in NEHC/SSC-SD 2005a) and TDM (see Section 2.4, p2-14 in NEHC/SSC-SD 2005b) there are also additional uncertainties associated with using the model results to address ecological risks.

The output from the TDM was used to predict the release and accumulation of PCBs from the ship for the period of 0-2 yrs in 15 m bins extending out to 3000 m (see Appendix B and C of NEHC/SSC-SD 2005b for the details of these simulations). While the progressive food chain used in the TDM-PRAM simulations was developed to take into account changes in the food web during colonization, the time series of abiotic concentrations were used to project steady state tissue concentrations at each of the intervals (NEHC/SSC-SD 2005b). Clearly, it would take time for the reef community to fully develop and to reach a "steady state" with the exposure levels present. Although it could take years to reach thermodynamic steady state, studies have shown relatively rapid uptake of PCBs by fish (Fisk et al. 1998) and mussels (Bergen et al. 1998) indicating that marine communities can achieve 70-80% of the "steady-state" concentration within a month of exposure to high concentrations of PCBs. While PRAM may still overestimate tissue concentrations, there may be components of food web that can reach equilibrium quickly and the PRAM output can be viewed as representing the portion of the reef community that would be most directly affected.

The ZOI was developed to define the model boundaries and the recommended ZOIs are germane to assessing human health risks (NEHC/SSC-SD 2005a, b). However, the ZOI has little meaning to sessile organisms and other epibenthic critters that will spend their entire life span only a few millimeters away from the substrate provided by the ship. These organisms will probably encompass the vast majority of the biomass present at the reef and provide the food and cover that will attract and support the higher trophic level organisms prized by anglers. Because of this, it is appropriate to focus the ecorisk analysis on the smallest perimeter possible, which was the community most closely associated with the hull (ZOI=1, 0 m) and areas directly adjacent to the reef (ZOI=2, 15 m and ZOI=3, 27 m).

Many other ecological processes, that may also affect PCB bioaccumulation and potential risks, were not addressed by TDM-PRAM and PRAM. These include increased productivity, changes in biomass and abundance within the trophic structure, refugia, disequlibrium population dynamics between predators and prey, and ecosystem dynamics just to mention a few.

6.4.2 Exposure to Dioxin-like TEQ

The exposure to dioxin-like coplanar congeners to birds and mammals was evaluated using the dietary HQs calculated from the modeled TEQs in prey of dolphins, cormorants, and herring gulls (Appendix 3.5). The mammalian TEQs calculated in the reef biota ranged from 0.37 and 0.19 pg TEQ/g WW for grouper and triggerfish to less than 0.01 pg TEQ/g WW for the other organisms (Figure 45). The avian TEQs were slightly higher, 0.45 pg TEQ/g WW for grouper, 0.38 pg TEQ/g WW for triggerfish, and 0.27 pg TEQ/g WW for crab (Figure 46). The avian TEQs were slightly higher than those obtained for mammals because the avian TEFs for tetrachlorobiphenyl congeners PCB077 and PCB081 are higher than the mammalian TEFs (Table 17) and those congeners accounted for about 65% and 10% of the avian TEQ, respectively. The mammalian TEQ was comprised of mainly pentachlorobiphenyl congeners PCB105 (66%) and PCB114 (12%). The HQ calculated for dietary exposure to dolphins, cormorants, and gulls were < 0.1 for dolphins (Figure 47) and < 0.01 for cormorants and gulls (Figure 48) suggesting that it is extremely unlikely that TEQ exposure is harmful to dolphin and avian consumers at the reef.

TEQ exposure to fish eggs and sac-fry larvae, the most sensitive life stage of fishes to TEQ toxicity, was calculated based on the maternal transfer of TEQs to fish eggs on a wet weight and lipid weight basis (Appendix 3.5). The fish egg TEQ was highest for grouper and triggerfish for both the wet weight (Figure 50) and lipid weight calculations (Figure 51). Pentachlorobiphenyl congener PCB105 accounted for about 75% of the fish egg TEQ. The HQs for TEQ effects to fish eggs and sac-fry larvae were below 0.1 for both the wet weight (Figure 52) and lipid-based benchmarks (Figure 53), suggesting that it was extremely unlikely that TEQ exposure is harmful to fish eggs that are laid and hatched at the reef.

Based on the data available for evaluating TEQ exposures to dolphin, birds, and fish eggs, the risk of exposure from TEQ in the diet of dolphins and birds and the maternal transfer of TEQ to fish eggs is negligible Table 27.

6.4.2.1 Uncertainty

The main source of uncertainty about the TEQ analysis was that coplanar congeners were not modeled directly, their concentration was estimated by assuming that the proportionality between the coplanar congeners and the homologs observed in the leachrate experiments was constant and preserved in the food chain. This hinges on the assumption that the behavior of the coplanar congeners is mostly controlled by the physiochemical properties modeled within PRAM, specifically molecular weight, solubility, vapor pressure, Henry’s Law constant, K_{ow}, K_{oc}, and K_{doc}. Since these parameters are used for the homolog, which has very similar properties to the congeners within a homolog group (Hawker and Connell 1988), these are probably pretty good estimates for the individual congeners. However, PRAM does not model biotransformations or varying elimination rates that may occur and biodegradation was set to zero for the PRAM simulations conducted for this risk assessment. The proportionality assumption is a conservative estimate, if the bioaccumulation of coplanar congeners is equal to or less than what is expected for the homolog group.

Other studies have shown that coplanar and non-coplanar PCBs accumulate in relatively the same manner in marine food webs. Fisk et al. (2001) reported on food web biomagnification factors (FWMF, see EQU [33]) from the Northwater Polyna in the Arctic for 36 congeners including some of the coplanar congeners (PCB105, PCB118, PCB156, and PCB180); Mackintosh et al. (2004) described the trophic transfer of PCB018, PCB099, PCB118, PCB180, PCB194, and PCB209 for a coastal marine food web in False Creek Harbor, British Columbia; and Wan et al. (2005) reported FWMF for dioxins, furans, and dioxin-like coplanar PCBs (including one non-coplanar PCB169) in the marine food web of Bohai Bay, China. These data represent a wide range of marine systems for comparing the biomagnification factors predicted by PRAM. The average FWMFs determined for coplanar and non-coplanar congeners were similar for tetra-, penta- (Figure 54), hexa-, and heptachlorobiphenyls (Figure 55). In addition the FWMFs obtained from PRAM for the pelagic, benthic, and reef communities spanned the range of FWMFs reported for coplanar and non-coplanar congeners from the other studies cited above (Figure 56).

This bolsters the assertion that dioxin-like coplanar congeners are present in the food web in proportion to homologs, or at least, is not underestimating the presence of dioxin-like congeners. Wan et al. (2005) reported the FWMF for the coplanar PCBs were much higher than the FWMFs obtained for dioxins and furans, probably due to the metabolic transformations that lead to elimination and lower half-lives of dioxins and furans than for PCBs. Wan et al. (2005) found that the FWMF for hexachlorobiphenyl coplanar congeners PCB156, PCB157, and PCB167 were much lower (3.55, 3.7, and 3.37, respectively) than the non-coplanar PCB169 (12.26). Mackintosh et al. (2004) reported similar FWMFs for pentachlorobiphenyl of 6.98 (3.77 – 12.81 95% CL) for coplanar congener PCB118 and 4.89 (2.85 – 9.39 95% CL) for non-coplanar congener PCB099. In a study of the uptake of sediment bound PCBs by carp (*Cyprinus carpio*) Moermund et al. (2004) reported data that showed pentachlorobiphenyl coplanar congeners PCB105 and PCB118 were bioaccumulated about half as much as the non-coplanar congener PCB101, however it is not possible to tell whether this was due to differential desorption from the sediment or biotransformations in the fish.

Another source of uncertainty was that PCB123, PCB126, PCB169, and PCB189 were not detected during the leachrate experiments so these compounds did not contribute to the TEQs calculated. Because the leachrate experiments were following a chemical process (George et al. 2005), normal methods for estimating non-detected concentrations based on sampling theory are not applicable. Therefore no attempt was made to estimate concentrations for the non-dected congeners.

6.5 Summary of Findings

The outputs of the TDM-PRAM and PRAM models were used to evaluate PCB exposures to the pelagic, benthic, and reef communities as well as dolphins, sea birds, sea turtles, and shark/barracuda that may be attracted to feed and forage on the reef. Predicted sediment and water concentrations were well below ecorisk benchmarks for both short-term and long-term exposure. Tissue concentrations predicted for the pelagic and benthic community were below expected background PCB concentrations determined from EMAP and IMAP data. The modeled concentrations in the upper trophic level of the reef community were within the range of background PCB values for the Gulf of Mexico. The PCB exposure levels predicted by the models were extremely to very unlikely of causing ecological effects because the concentrations of Total PCBs were well below the benchmarks of ecological effects.

Estimates of TEQ exposure were obtained by assuming that dioxin-like coplanar congeners would be present in same congener:homolog proportion observed in the leachrate experiments. Potential risks from dietary exposure of TEQs to gulls, cormorants and dolphins were evaluated by comparing modeled tissue concentrations in prey to TEQ dietary benchmarks for those species. Potential risks of TEQ exposure to fish eggs and sac-fry larvae, the most sensitive life stage of fishes to TEQ toxicity, were evaluated by predicting the maternal transfer of TEQs to fish eggs and comparing the resulting fish egg concentrations to sensitive egg residue benchmarks for TEQ exposure. It is extremely unlikely that the modeled TEQ exposure will cause an effect to dolphins, sea birds, or fish eggs and larvae because the modeled TEQ concentrations were well below the ecorisk benchmarks.

Based on the data available for evaluating tissue exposures to reef organisms, the risk of exposure from Total PCB in tissues of organisms associated with the reef and in the diet of reef consumers is negligible. Based on the data available for evaluating TEQ exposures to dolphin, birds, and fish eggs, the risk of exposure from TEQ in the diet of dolphins and birds and the maternal transfer of TEQ to fish eggs is negligible Table 27.

Photo by Keith Mille (keith.mille@MyFWC.com)
Florida Fish & Wildlife Conservation Commission

7. Uncertainty

We demand rigidly defined areas of doubt and uncertainty!

Douglas Adams

The purpose of this section is to summarize the sources of uncertainty, identify procedures and precautions taken to reduce uncertainty to the extent possible, and discuss the ramifications of uncertainty in the conclusions drawn from the risk characterization. This section provides a concise summary of major sources of uncertainty identified during the risk assessment. Specific sources of uncertainty were discussed throughout the document and are, therefore, not repeated here. The major sources of uncertainty in the risk assessment arise from errors in assumptions, errors made during measurement activities, errors that occurred during analyses, and the natural variability in the components of the ecosystem that were studied.

7.1 Contaminant Source Terms for ex-ORISKANY

As was discussed in Section 3.4, the ex-ORISKANY underwent an extensive cleanup program in accordance with the draft Best Management Practices for Preparing Vessels Intended to Create Artificial Reefs (US EPA and MARAD 2004). Many PCB containing materials were removed from the ship, but some materials remained on the ship and there is uncertainty about the amount of materials, the fraction of PCBs contained in the materials, and the rate at which PCBs will be leached out. The upper bound of the mass fraction in the PCB materials was estimated using jack-knife and bootstrap methods and the 95th percentile or maximum leach rates were used for the materials so these represent the upper bound, or worst case of what could be leached from the vessel (NEHC/SSC-SD 2005a, b). The uncertainty about the materials left on board was evaluated with PRAM by varying the amount of bulkhead insulation (BHI) left onboard the ship. The BHI had the highest leach rate of any of the materials tested, so varying the amount of BHI directly affects the amount of PCBs released per day (ng/day) into the model. The default mass of BHI on the ship (14,379 Kg) was increased to the amount present before cleanup (52,478 Kg), an intermediate amount (26,000 Kg) and reduced to 10% of the precleanup mass (5,247 Kg), and removed completely (0 Kg) to evaluate the effect of PCB loadings on PRAM predictions.

Changing the amount of BHI on the ship changed the release rate and the concentrations of biotic and abiotic media changed in a linear fashion (Figure 57, Appendix D.2 PCB Release Rate). The original amount of BHI onboard the vessel prior to cleaning increased the biota and abiotic media by about a factor of 3 above the default levels and removing the BHI completely reduced tissue concentrations by about a factor of 4.5 from the default levels, most notably, triggerfish and flounder concentration were reduced by a factor of 7. Removing all BHI also reduced interior vessel water and lower water column concentrations by a factor of 2.6 and sediment concentrations by a factor of 2.2 from the default levels.

7.2 Applicability of Assessment endpoints

Based on existing toxicological data, receptor species for the reef community were selected that were taxonomically similar to species for which toxicity data were available (or could be inferred) and that would most likely be sensitive to PCBs. Toxicological data were reviewed to identify available toxicological benchmarks that could be used to interpret whether exposure concentrations to the receptor species could be harmful. To the extent possible, receptor species were selected that were representative of mammals, birds, reptiles, fishes, and invertebrates that utilize reef habitats. In many cases, toxicological data were not available for reef organisms and the susceptibility of the receptor species to PCBs had to be inferred or extrapolated from species used in toxicological tests and studies.

7.3 Applicability of Water Quality Criteria Benchmarks

The water column, TSV, and B_{CV} benchmarks were based on Water Quality Criteria (WQC). According to EPA's Aquatic Life Criteria Guidelines Committee, which is responsible for developing the technical basis for national WQC, water quality criteria are considered to be protective of 95% of the species tested (or more precisely, of the genera tested). The standard WQC calculation results in a number that is designed to protect 95% of the species sensitivity distribution represented by the data set available. The assumption here is that the data set available is representative of the species sensitivity distribution of the potentially exposed aquatic community. To the degree that this assumption is true, WQC protect 95% of the species exposed. The data set is biased in two ways: 1) the species tested generally are among the more sensitive species that can be tested; and 2) only species that can be tested are tested – species that are more difficult to maintain in the laboratory could be more sensitive than those actually tested. By implication, a sensitive species of particular value, or of particular importance to community and ecosystems dynamics (a "keystone" species), for which no toxicity test data exist, could be adversely affected at exposure concentrations lower than the WQC.

7.4 Applicability of Critical Body Residue Benchmarks

Critical body residues (CBR) are defined as the threshold concentration of a contaminant in the tissue of an organism above which adverse effects could occur (McCarty et al. 1992, Pabst 1999). Data obtained from the ERED database were used to develop benchmarks for effects on reproduction, growth and development, mortality and survival. The benchmarks were based whole body concentration and ingestion or absorption. In many cases, data for freshwater fish and invertebrates were used to develop the benchmarks because of the paucity of data on marine organisms in general and reef organisms in particular. The CBR benchmarks assumed that the tissue concentration causing adverse effects in an organism would be the same for both marine and freshwater organisms. This assumes that the difference between freshwater and saltwater criteria are due to differences in chemical uptake in freshwater and marine organism and not differences in tissue concentrations that would cause adverse effects.

7.5 Applicability of Dietary Benchmarks

Sample et al. (1996) reported that scaling factors, such as used for mammals, are not appropriate for avian species because an analysis of existing data showed that the scaling factor which ranged from 0.63 to 1.55 with a mean of 1.15, was not significantly different than 1. This assumes that toxicity effects to receptor species (birds of prey) would be similar to the species tested (ring-necked pheasant for PCBs) after adjusting for differences in food consumption rate and body weight of the receptor species.

It was also assumed that dietary benchmarks based on reproductive effects to mink were appropriate and applicable to dolphins. While dolphins and mink are both piscivores they have very different life histories, dietary requirements, and feeding behaviors. In a study of PCB risk to bottlenose dolphins (*Tursiops truncates*), Schwacke et al. (2002) justified the use of mink as surrogates for dolphins because mink are the most sensitive mammalian species for which PCB toxicity data are available and that mink have similar pharmokinetic pathways as dolphins (cetaceans), specifically, both have relatively lower levels of phenobarbital-type (PB-type) and 3-methylcholanthrene-type (MC-type) enzymes necessary for metabolizing PCBs than other birds or mammals. Additionally, it is very difficult to obtain toxicological data for a protected species such as dolphins (Schwacke et al. 2002).

Due to the lack of toxicity data on reptiles, the lowest TRVs obtained for mammalian species (mammals are more sensitive to PCBs than birds) was assumed to be protective of sea turtles. Using the same scaling factors used for mammals and substituting the body weight and ingestion rate of loggerhead turtles the PCB benchmarks for sea turtles were obtained. This assumed that if the benchmarks were protective of warm-blooded mammals, then they would also be protective of cold-blooded sea turtles.

Toxicological benchmarks for PCBs in shark and barracuda were developed using the ratio of food chain multiplier (FCMs) between TL4 (reef predator, e.g. shark) and TL3 (reef forager, e.g. prey) obtained from US EPA (2000). The ratio between FCMs for TL4 and TL3 gives the relative increase in contaminant concentrations between a shark and its prey, assuming all the shark's dietary requirements came from TL3. This assumes that a steady state exists between the shark and its prey and that accumulation from the water through gill exchange would be negligible compared to contaminant uptake from food. The analysis also assumed that when sharks feed on TL4 prey the same FCM would be applicable. This is conservative because, generally FCM decreases for higher trophic levels.

7.6 Uncertainty About Water and Sediment Exposure

Release of PCBs from the ship and build up in the water and sediment around the reef is controlled primary by the bottom currents. Higher bottom currents will increase the rate PCBs are moved out of the ship but they will also increase the rate the PCBs are advected out of the model domain (NEHC/SSC-SD 2005b). On the other hand, lower currents will move less mass, but the lower currents will increase the residence time of PCBs and allow more PCBs to be sorbed onto sediments and accumulated within the food chain. The uncertainty about water and sediment exposure was evaluated as function of bottom current. In PRAM the bottom current is used to calculate the speed with which water moves through the ZOI directly affecting the residence time and the advection rate of PCBs out of the system. The default bottom current of 926 m/h was decreased by half (465 m/h) and by a factor of 10 (93 m/h) and increased by doubling (1858 m/h) and by a factor of 10 (9260 m/h) to evaluate the effect on the PCB concentrations in biotic and abiotic media of the model[11] (Figure 58, Appendix D.1 Bottom Current).

Linear changes in the speed of the bottom current resulted in linear changes to the PCB concentrations of the abiotic media and the biological components of the pelagic and benthic communities. Halving the bottom currents doubled the PCB concentrations in the lower water column and sediment and quadrupled the concentrations in the upper water column, which resulted in about twice the residue levels in the pelagic and benthic communities. The effect was the same in the other direction – increasing bottom currents by a factor of 2 halved the sediment and lower water column concentrations, decreased the upper water column by a factor of 4 and reduced PCB levels in the pelagic and benthic communities by about a factor of 2. The PCB levels in the upper trophic levels of the reef community did not appreciably change as a function of the bottom currents, probably because their residues are more controlled by direct contact with interior vessel water.

7.7 Uncertainty about Food Chain

The food chain modeled by PRAM is a simplification of a very complex ecosystem. Each "species" modeled by PRAM is meant to be representative of a vast range of organisms that are associated with the reef. Due to the structure of the model, the overriding factor governing PCB accumulation in the food chain is through contact with the interior water of the ship. While the interior of the vessel was not considered a viable habitat it is certainly plausible that certain organisms may colonize the interior of the vessel and live out their lives relatively isolated from the rest of the reef. Mobile organisms, like fish, octopi, crabs, echinoderms, and other invertebrates may also use the interior of the vessel to escape predators, sleep, or just simply hang out. To address the worst-case exposure from PCBs in the interior water of the vessel, the default interior water exposure for bivalves (0%) was changed to 50% and 99%.[12] The effect on PCB concentrations in biota as function of increasing bivalve exposure to interior vessel water is shown in Figure 59 and tabulated in Appendix D.3 Bivalve Exposure to Interior Vessel Water. The bivalve tissue concentrations increased by a factor of 175 and 346 as the exposure to interior vessel water was increased to 50% and 99%, respectively. In addition, the rest of the reef community food chain also increased by about a factor of 3 and 5 as a result of increasing the bivalve's interior water exposure to 50% and 99%, respectively. This was because bivalves comprised 20% of the diet for urchins, 35% of the diet for crabs, and 19% of the triggerfish's diet. The bivalve's tissue residues did not exceed any benchmark for either increase, but the 50%

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[11] In the PRAM documentation the exchange between interior vessel water and lower water column was listed as being proportional to the bottom currents, but this was not the case. The exchange rate between interior water and the lower water column remained constant at 9.26 m/h for all values of bottom current tested.

[12] PRAM is not able to accept 0 as a parameter value for fraction exposure to lower water column.

increase in exposure to interior water caused the HQ for dolphin consumption to be very close to 1 for grouper (0.989), triggerfish (0.605), and crab (0.329) and the 100% increase caused the grouper's tissue residues to exceed the dolphin and TSV benchmarks. This represents an extremely conservative upper bound estimate of potential risk.

7.8 Uncertainty about Risk from Dixon-like Toxicity

Data from dioxin-like coplanar congeners were multiplied by the respective TEFs to calculate TEQs for fish eggs and to assess dietary exposure to birds and mammals. Because no data were available for PCB081[13] the concentrations of PCB081 were estimated assuming that they were proportional to PCB077 in ratios that were measured other studies (Johnston et al. 2005). The maternal transfer of PCBs from reef fish to egg was also assumed to be proportional to the transfer ratios reported for trout. The dioxin-like TEFs and TEQ benchmarks were also assumed to be applicable to fish, birds, and mammals foraging on the reef. The potential risk estimated from TEQ exposure to fish eggs and dietary exposure to birds and mammals were based only on dioxin-like toxicity from PCBs and did not take into account any additional toxicity from the presence of dioxins and furans.

The most toxic dioxin-like PCB congener, PCB126, and PCB123, PCB169, and PCB189 were not detected during the leachrate experiments so these compounds did not contribute to the TEQs calculated. Because the leachrate experiments were following a chemical process (George et al. 2005), normal methods for estimating non-detected concentrations based on sampling theory are not applicable. Therefore no attempt was made to estimate concentrations for them.

There is a wide range of sensitively to dioxins among fish, birds, and mammals (Gatehouse 2004). The benchmarks used in this analysis were based on data available for the most sensitive fish (salmonids), avian (order of galliformes – chicken-like birds e.g. pheasant) and mammal (mink) for which toxicity data are available (Gatehouse 2004) and it was assumed that these benchmarks would not under estimate the potential risk to receptors on the reef. Additionally, the dietary benchmarks assumed that the reef con-sumers dined exclusively on the reef throughout their whole life span with an assimilation

Photo by Keith Mille (keith.mille@MyFWC.com) Florida Fish & Wildlife Conservation Commission

[13] PCB081 was not tested for in the leachrate experiments.

efficiency of 90%. Reducing these parameters would increase the dietary benchmarks by the same factor.

8. Conclusions and Recommendation

The purpose of this report is to assess the ecological risks associated with sinking the aircraft carrier ex-ORISKANY (CVA-34, Figure 1) to create an artificial reef off the coast of Pensacola, FL (Figure 2) within the Escambia East Large Area Artificial Reef Site (Figure 3). Because the ex-ORISKANY contains solid materials such as electrical cabling, gaskets, rubber products, and paints that contain concentrations of polychlorinated biphenyls (PCBs) ≥ 50 ppm, the vessel is regulated as PCB Bulk Product Waste under 40 CFR 761.62(c) and a risk-based disposal permit is required prior to sinking the vessel.

8.1 Summary of Findings

The outputs of the TDM-PRAM and PRAM models were used to evaluate PCB exposures to the pelagic, benthic, and reef communities as well as dolphins, sea birds, sea turtles, and shark/barracuda that may be attracted to feed and forage on the reef. Predicted sediment and water concentrations were well below ecorisk benchmarks for both short-term and long-term exposure. Tissue concentrations predicted for the pelagic and benthic community were below expected background PCB concentrations determined from EMAP and IMAP data. The modeled concentrations in the upper trophic level of the reef community were within the range of background PCB values for the Gulf of Mexico. The PCB exposure levels predicted by the models were extremely to very unlikely of causing ecological effects because the concentrations of Total PCBs were well below the benchmarks of ecological effects.

Estimates of dioxin-like PCB (TEQ) exposure were obtained by assuming that dioxin-like coplanar congeners would be present in the same congener:homolog proportion observed in the leachrate experiments. Potential risks from dietary exposure of TEQs to gulls, cormorants and dolphins were evaluated by comparing modeled tissue concentrations in prey to TEQ dietary benchmarks for those species. Potential risks of TEQ exposure to fish eggs and sac-fry larvae, the most sensitive life stage of fishes to TEQ toxicity, were evaluated by predicting the maternal transfer of TEQs to fish eggs and comparing the resulting fish egg concentrations to sensitive egg residue benchmarks for TEQ exposure. It is extremely unlikely that the modeled TEQ exposure will cause an effect to dolphins, sea birds, or fish eggs and larvae because the modeled TEQ concentrations were well below the ecorisk benchmarks.

Based on the data available for evaluating tissue exposures to reef organisms, the risk of exposure from Total PCB in tissues of organisms associated with the reef and in the diet of reef consumers is negligible. Based on the data available for evaluating TEQ exposures to dolphin, birds, and fish eggs, the risk of exposure from TEQ in the diet of dolphins and birds and the maternal transfer of TEQ to fish eggs is negligible Table 27.

8.2 Uncertainty

Uncertainty in risk assessments arise from errors in assumptions, errors made during measurement activities, errors that occurred during analyses, and the natural variability in the components of the ecosystem that were studied. The major sources of uncertainty were the assumptions and parameters used in models, the applicability and sensitivity of the benchmarks used in the assessment, and uncertainty about the sources of PCBs on the vessel. Due to the conservative estimates used in this analysis, it is very unlikely that potential risks were under estimated.

8.3 Conclusions

The criteria used to evaluate the model performance showed that the outputs from PRAM are plausible and reasonably good estimates of what would occur given that the other model assumptions and procedures are also accurate. Based on the data available for evaluating sediment, water, and tissue residue exposures to reef organisms, the risk of exposure from Total PCB and dioxin-like toxicity equivalents in tissues of organisms associated with the reef and in the diet of reef consumers is negligible. Therefore, it is unlikely that PCBs released from sinking the ex-ORISKANY to create an underwater reef will harm the environment.

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10. Tables

Table 1. The average and range of total PCB concentrations measured in fish samples from the EMAP and IMAP monitoring studies for the SE U.S.

			ng/g Dry Weight				mg/Kg Wet Weight			
Location	Species	n	Average	Std	Min	Max	Average	Std	Min	Max
EMAP Louisanian Provience (All)	Croaker	219	40.4	103.8	3.4	866.3	1.01E-02	2.59E-02	8.39E-04	2.17E-01
EMAP Louisanian Provience (FL)	Croaker	14	34.2	72.9	4.4	283.1	8.56E-03	1.82E-02	1.09E-03	7.08E-02
IMAP (Pensacola)	Sea Robin, Spot, Pigfish	3	107.2	101.9	24.7	221.1	2.68E-02	2.55E-02	6.18E-03	5.53E-02
EMAP Carolianian Provience	Croaker	18	98.7	87.2	19.4	343.4	2.47E-02	2.18E-02	4.84E-03	8.59E-02
EMAP Carolianian Provience	Spot	8	55.0	42.9	15.9	141.7	1.37E-02	1.07E-02	3.99E-03	3.54E-02

Table 2. Data Provided by PRAM to be used in the ecorisk assessment. (A) Abiotic concentrations, (B) tissue concentrations

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(A) Abiotic PCB concentrations provided by TDM

Outside the Vessel		
	Freely dissolved in water[a]	Upper and lower water column
	Suspended solids[a]	Upper and lower water column
	Dissolved organic carbon[a]	Upper and lower water column
	Bedded sediment	
	Sediment porewater	
Inside the Vessel		
	Freely dissolved in water[b]	
	Suspended solids[b]	
	Dissolved organic carbon[b]	

(B) Tissue Concentrations for representative species in the food chain of the reef from Table 8 in PRAM documentation.

	Assessment Endpoint	Representative Species
Pelagic Community		
	Phytoplankton (TL1)	algae
	Zooplankton (TL-II)	copepods
	Planktivore (TL-III)	herring
	Piscivore (TL-IV)	jack
Reef / Vessel Community		
	Attached algae (TL-I)	algae
	Sessile filter feeder (TL-II)	bivalves
	Grazing / foraging omnivore (TL-II)	urchin
	Invertebrate forager (TL-III)	crab
	Vertebrate forager (TL-III)	triggerfish
	Predator (TL-IV)	grouper
Benthic Community		
	Infaunal invertebrate (TL-II)	polychaete
	Epifaunal invertebrate (TL-II)	nematode
	Forager (TL-III)	lobster
	Predator (TL-IV)	flounder

[a]. Data used to calculate upper and lower bulk water concentration
[b]. Data used to calculate interior bulk water concentration

Table 3. Ecorisk assessment endpoints. (A) Assessment endpoints modeled directly by PRAM and TDM, (B) assessment endpoint evaluated by inferring risk from dietary exposures

Table 3(A). Assessment endpoints for reef community modeled by PRAM.

TISSUE CONCENTRATION (Provided by PRAM)	Representative Species
TERIARY CONSUMERS	
Pelagic/Piscivore (TL-IV)	jack
Benthic/Predator (TL-IV)	flounder
Reef/Predator (TL-IV)	grouper
SECONDARY CONSUMERS	
Benthic/Forager (TL-III)	lobster
Reef/Forager (TL-III)	triggerfish
Pelagic/Planktivore (TL-III)	herring
PRIMARY CONSUMER	
Benthic/Infaunal invert. (TL-II)	polychaete
Benthic/Epifaunal invert. (TL-II)	nematode
Reef/Sessile filter feeder (TL-II)	bivalves
Reef/Grazer (TL-II)	urchin
Pelagic/Zooplankton (TL-II)	copepods
PRIMARY PRODUCER	
Reef/Attached algae (TL1)	algae
Pelagic/Phytoplankton (TL1)	algae
SEDIMENT (Calculated with data from TDM)	
Bulk Sediment outside the vessel	
WATER (Calculated with data from TDM)	
Bulk Water Concentration outside the vessel	Upper and lower water column
Bulk Water Concentration inside the vessel	

Table 3. Cont.

Table 3(B) Assessment endpoints evaluated by inferring risk from dietary exposures.

DIET (provided by PRAM)	Representative Species
REEF CONSUMERS	
Dolphin	
Reef/Predator (TL-IV)	grouper
Reef/Vertebrate forager (TL-III)	triggerfish
Reef/Invertebrate forager (TL-III)	crab
Benthic/Predator (TL-IV)	flounder
Benthic/Forager (TL-III)	lobster
Pelagic/Planktivore (TL-III)	herring
Pelagic/Piscivore (TL-IV)	jack
Reef Shark/Barracuda	
Reef/Predator (TL-IV)	grouper
Reef/Vertebrate forager (TL-III)	triggerfish
Benthic/Predator (TL-IV)	flounder
Pelagic/Planktivore (TL-III)	herring
Pelagic/Piscivore (TL-IV)	jack
Sea Turtle	
Benthic/Forager (TL-III)	lobster
Reef/Invertebrate Forager (TL-III)	crab
Reef/Grazer (TL-II)	urchin
Reef/Sessile filter feeder	bivalves
AVIAN CONSUMERS	
Cormorant	
Pelagic/Planktivore (TL-III)	herring
Pelagic/Piscivore (TL-IV)	jack
Reef/Forager (TL-III)	triggerfish
Reef/Predator (TL-IV)	grouper
Benthic/Predator (TL-IV)	flounder
Herring Gull	
Pelagic/Planktivore (TL-III)	herring
Pelagic/Piscivore (TL-IV)	jack
Reef/Sessile filter feeder (TL-II)	bivalves
Reef/Grazer (TL-II)	urchin
Reef/Invertebrate Forager (TL-III)	crab
Reef/Vertebrate Forager (TL-III)	triggerfish
Reef/Predator (TL-IV)	grouper
Benthic/Epifaunal invert. (TL-II)	nematode
Benthic/Forager (TL-III)	lobster
Benthic/Predator (TL-IV)	flounder

Table 4. The average and 95% upper confidence level (UCL) of PCB containing material and mass of PCBs estimated to be onboard the ex-ORISKANY before and after vessel preparations. Data from Pape 2004.

A. PCB containing materials before vessel preparation

	Units	Ventilation Gaskets	Black Rubber Material	Electrical Cable[b]	Bulkhead Insulation Material	Aluminized Paint	Lubricants	Total Mass
[a] Weight on ship when built	lbs	2680.0	11989.0	558538.6	115695.0	298999.0	208140.0	
[a] Weight on ship when built	kg	1215.6	5438.1	253348.9	52478.4	135623.7	94410.7	
Factor gained during lifecycle		1.2	1.0	1.3	1.0	3.0	1.0	
Total weight on ship	lbs	3216.0	11989.0	726100.2	115695.0	896997.0	208140.0	
Total weight on ship	kg	1458.8	5438.1	329353.5	52478.4	406871.0	94410.7	
Averge PCB Concn.	ppm	20.3	37.3	1079.49	215.1	11.6	60.3	
95% UCL Concn.	ppm	33.5	50.9	1998.71	587.7	19.7	22.2	
Mass of PCBs (avg)	lbs	0.07	0.45	783.82	24.9	10.41	12.55	832.17
Mass of PCBs (95% UCL)	lbs	0.11	0.61	1451.26	68.0	17.67	4.62	1542.27
Mass of PCBs (avg)	kg	0.03	0.20	355.53	11.29	4.72	5.69	377.47
Mass of PCBs (95% UCL)	kg	0.05	0.28	658.28	30.84	8.02	2.10	699.56
fraction PCB (avg)		0.0000203	0.0000373	0.0010795	0.0002151	0.0000116	0.0000603	
fraction PCB (max)		0.0000335	0.0000509	0.0019987	0.0005877	0.0000197	0.0000222	
% of total mass (avg)		0.01%	0.05%	94.19%	2.99%	1.25%	1.51%	
% of total mass (max)		0.01%	0.04%	94.10%	4.41%	1.15%	0.30%	

B. PCB containing materials after vessel preparation

	Units	Ventilation Gaskets	Black Rubber Material	Electrical Cable[b]	Bulkhead Insulation Material	Aluminized Paint	Lubricants	Total Mass
[a] Weight on ship when built	lbs	2680.0	11989.0	502684.7	31700.4	284049.1	0.0	
[a] Weight on ship when built	kg	1215.6	5438.1	228014.0	14379.1	128842.5	0.0	
Factor gained during lifecycle		1.2	1.0	1.3	1.0	3.0	1.0	
Total weight on ship	lbs	3216.0	11989.0	653490.2	31700.4	852147.2	0.0	
Total weight on ship	kg	1458.8	5438.1	296418.2	14379.1	386527.4	0.0	
Averge PCB Concn.	ppm	20.3	37.3	1079.49	215.1	11.6	60.3	
95% UCL Concn.	ppm	33.5	50.9	1998.71	587.7	19.7	22.2	
Mass of PCBs (avg)	lbs	0.07	0.45	705.44	6.8	9.88	0.00	722.65
Mass of PCBs (95% UCL)	lbs	0.11	0.61	1306.14	18.6	16.79	0.00	1342.27
Mass of PCBs (avg)	kg	0.03	0.20	319.98	3.09	4.48	0.00	327.79
Mass of PCBs (95% UCL)	kg	0.05	0.28	592.45	8.45	7.61	0.00	608.85
fraction PCB (avg)		0.0000203	0.0000373	0.0010795	0.0002151	0.0000116	0.0000603	
fraction PCB (max)		0.0000335	0.0000509	0.0019987	0.0005877	0.0000197	0.0000222	
% of total mass (avg)		0.01%	0.06%	97.62%	0.94%	1.37%	0.00%	
% of total mass (max)		0.01%	0.05%	97.31%	1.39%	1.25%	0.00%	

[a] Final Weight Report, Aircraft Carrier CV9 USS ESSEX, Office of Supervisor of Shipbuilding for US Navy, Newport News Shipbuilding and Dry Dock Company, Newport New, VA

[b] Electrical cable normalized to intact electrical cable (0.7226 g insulation/g cable)

Table 5. The mass of materials, fraction of PCBs, and total PCB release rates used to calculate PCB loading from the ex-ORISKANY for PRAM defaults (A), input to the TDM model (B), and the average (C) and 95% UCL (D) from Pape 2004.

A. PRAM Defaults	Ventilation Gaskets	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint	Total
Fraction PCB in Material (wt/wt)	0.0000314	0.0000529	0.00185	0.000537	0.00002	
Material Mass Onboard (kg)	1,459	5,397	296,419	14,379	386,528	704,182
Total PCBs (kg)	0.0458126	0.2855013	548.37515	7.721523	7.73056	564.2
Total PCB Release rate (ng/g-PCB per day)	1577.1	1577.1	279.0	67635.4	11148.3	
Material Mass Onboard(lb)	3216.54	11898.35	653492.03	31700.27	852148.37	1,552,455.57
Total PCBs (lb)	0.100999494	0.629422624	1208.96026	17.02304427	17.04296744	1,243.76
Daily PCB Release Rate (ng/day)	7.23E+04	4.50E+05	1.53E+08	5.22E+08	8.62E+07	7.62E+08

B. TDM Inputs	Ventilation Gaskets	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint	Total
Fraction PCB in Material (wt/wt)	0.0000314	0.0000529	0.00185	0.000537	0.00002	
Material Mass Onboard (kg)	1,459	5,397	296,419	14,379	386,528	704,182
Total PCBs (kg)	0.0458126	0.2855013	548.37515	7.721523	7.73056	564.2
Total PCB Release rate (ng/g-PCB per day)	1577.1	1577.1	279.0	67635.4	11148.3	
Material Mass Onboard(lb)	3216.54	11898.35	653492.03	31700.27	852148.37	1,552,455.57
Total PCBs (lb)	0.100999494	0.629422624	1208.96026	17.02304427	17.04296744	1,243.76
Daily PCB Release Rate (ng/day)	7.23E+04	4.50E+05	1.53E+08	5.22E+08	8.62E+07	7.62E+08

C. CACI 2004 average	Ventilation Gaskets	Black Rubber Material	Electrical Cable (intact)	Bulkhead Insulation Material	Aluminized Paint	Total
Fraction PCB in Material (wt/wt) average	0.0000203	0.0000373	0.001079492	0.0002151	0.0000116	
Material Mass Onboard (kg)	1,459	5,397	296,418	14,379	386,527	704,180
Total PCBs (kg)	0.029612687	0.201302207	319.981	3.092938642	4.48371837	327.8
Total PCB Release rate (ng/g-PCB per day)	1577.1	1577.1	279.0	67635.4	11148.3	82216.9
Material Mass Onboard (lb)	3216.00	11898.00	653490.17	31700.43	852147.15	1,552,451.75
Total PCBs (lb)	0.0652848	0.4437954	705.4375068	6.818762493	9.88490694	722.65
Daily PCB Release Rate (ng/day)	4.67E+04	3.17E+05	8.93E+07	2.09E+08	5.00E+07	3.49E+08

D. CACI 2004 95% UCL	Ventilation Gaskets	Black Rubber Material	Electrical Cable (intact)	Bulkhead Insulation Material	Aluminized Paint	Total
Fraction PCB in Material (wt/wt) 95% UCL	0.0000335	0.0000509	0.001998712	0.0005877	0.0000197	
Material Mass Onboard (kg)	1,459	5,397	296,418	14,379	386,527	704,180
Total PCBs (kg)	0.048868228	0.274699259	592.4544093	8.450581311	7.61459068	608.8
Total PCB Release rate (ng/g-PCB per day)	1577.1	1577.1	279.0	67635.4	11148.3	
Material Mass Onboard (lb)	3216.00	11898.00	653490.17	31700.43	852147.15	1,552,451.75
Total PCBs (lb)	0.107736	0.6056082	1306.1384	18.63034271	16.78729886	1,342.27
Daily PCB Release Rate (ng/day)	7.71E+04	4.33E+05	1.65E+08	5.72E+08	8.49E+07	8.22E+08

Table 6. Ecorisk benchmark concentrations for Total PCB (A) and dioxin-like PCB congener TEQ (B). Benchmark concentrations for water, sediment, and tissue residues of fish and invertebrates.

A. Benchmarks for exposure to TotalPCB.

Media	Exposure Pathway		Benchmark		units	Basis for Criterion
Water	Water	W_B		Water		Water Quality Criteria
		WQC-Chronic		0.000030	mg/L	U.S. EPA 1999a Saltwater CCC (chronic)
		GLWLC-Tier1		0.000074	mg/L	Great Lakes Wildlfie Citeria Tier1, U.S. EPA 1995
		GLWLC		0.000140	mg/L	Great Lakes Wildlfie Citeria, U.S. EPA 1995
		WQC-Acute		0.010000	mg/L	U.S. EPA 1999a Saltwater CCM (acute)
Sediment	Sediment	S_B		Sediment	units	State of Florida Sediment Assessment Guidelines (SQAGs)
		TEL		0.0216	mg/Kg dry	Threshold Effects Level (TEL)
		PEL		0.1890	mg/Kg dry	Probable Effects Level (PEL)
Tissue	Food Chain	T_{INVET}, T_{FISH}	Invertebrate	Fish	units	Potential Effects from Bioaccumulation
Residue		TSV	0.4368	0.4368	mg/Kg wet	Tissue Screening Value (URS 1996, 2000, Dyer et al 2000)
		Bcv	0.9360	7.4463	mg/Kg wet	Bioaccumulation Critical Value (Johnston 1999, Johnston et al. 2000)
Tissue	Food Chain		Invertebrate	Fish	units	Critical Body Residues
Residue		NOED	0.6000	1.5000	mg/Kg wet	No Observed Effects Dose
		LOED	1.1000	1.8000	mg/Kg wet	Lowest Observed Effects Dose
Tissue	Food Chain		Invertebrate	Fish	units	Dietary Exposure
Residue	Herring Gull	NOAELgull	0.8333	0.8333	mg/Kg wet	No Observed Adverse Effects Level
	Herring Gull	LOAELgull	8.3333	8.3333	mg/Kg wet	Lowest Observed Adverse Effects Level
	Cormorant	NOAELcorm		0.8000	mg/Kg wet	No Observed Adverse Effects Level
	Cormorant	LOAELcorm		8.0000	mg/Kg wet	Lowest Observed Adverse Effects Level
	Dolphin	NOAELdol	0.3166	0.3166	mg/Kg wet	No Observed Adverse Effects Level
	Dolphin	LOAELdol	1.5828	1.5828	mg/Kg wet	Lowest Observed Adverse Effects Level
	Sea Turtle	NOAELturtle	2.1788		mg/Kg wet	No Observed Adverse Effects Level
	Sea Turtle	LOAELturtle	10.8939		mg/Kg wet	Lowest Observed Adverse Effects Level
	Shark/Barracuda	NOAELshark		2.5196	mg/Kg wet	No Observed Adverse Effects Level
	Shark/Barracuda	LOAELshark		4.0658	mg/Kg wet	Lowest Observed Adverse Effects Level

Table 6. Cont.

B. Benchmarks for exposure to dioxin-like TEQs.

Media	Exposure Pathway	Benchmark				Basis for Criterion
Tissue	Maternal Transfer to Egg		Invertebrate	Fish	units	Critical Body Residues
Residue	Fish	EggNOED_Rainbow		0.300	pg TEQ/g Egg wet	No Observed Effects Dose (Rainbow Trout)
	Fish	EggNOED_Laketrout		5.000	pg TEQ/g Egg wet	No Observed Effects Dose (Lake Trout)
	Fish	EggLOEL_Laketrout		30.000	pg TEQ/g Egg wet	Lowest Observed Effects Dose (Lake Trout)
	Fish	EggLOEL_Rainbow(lipid)		3.000	pg TEQ/g Egg lipid	Lowest Observed Effects Dose (Rainbow Trout)
Tissue	Food Chain					Dietary Exposure
Residue	Herring Gull	NOAEL	64.815	64.815	pg TEQ/g wet	No Observed Adverse Effects Level
	Herring Gull	LOAEL	648.148	648.148	pg TEQ/g wet	Lowest Observed Adverse Effects Level
	Cormorant	NOAEL		62.222	pg TEQ/g wet	No Observed Adverse Effects Level
	Cormorant	LOAEL		622.222	pg TEQ/g wet	Lowest Observed Adverse Effects Level
	Dolphin	NOAEL	3.928	3.928	pg TEQ/g wet	No Observed Adverse Effects Level
	Dolphin	LOAEL	17.792	17.792	pg TEQ/g wet	Lowest Observed Adverse Effects Level

Table 7. Tissue Screening value (TSV) for tPCB (from URS 1996, 2002).

				dry:wet=	0.25	0.2
					TSV	
	AWQC[a]		BCF_{Lipid}[b]		Fish[c]	Shellfish[d]
	ug/L	Criterion Basis	L/kg wet	ug/g wet	ug/g dry	ug/g dry
tPCB	0.014	Freshwater Chronic	31200	0.437	1.75	2.18

[a] Ambient Water Quality Criteria used in derivation (URS 1996, 2002)

[b] Lipid normalized BCF for aquatic species (URS 1996, 2002)

[c] Assumes that fish contain 75% moisture resulting in a dry : wet ratio of 0.25

[d] Assumes that shellfish contain 80% moisture resulting in a dry : wet ratio of 0.2

Table 8. The calculation of bioaccumulation critical values (BCV) from bioconcentration factors (BCF) and water benchmarks (W_B) for tPCB (C) in fish and invertebrates.

C. Total PCB		dry:wet= 0.2			dry:wet= 0.25		
		Shellfish[a]			Fish[b]		
Chemical	W_B ug/L	BCF[c] (L/kg wet)	ug/g wet	ug/g dry	BCF[d] (L/kg wet)	ug/g wet	ug/g dry
tPCB	0.030 [e]	31200	0.936	4.68	248209	7.446	29.79
tPCB	0.074 [f]	31200	2.309	11.54	248209	18.367	73.47
tPCB	0.120 [g]	31200	3.744	18.72	248209	29.785	119.14

[a] Assumes that invertebrate contain 80% moisture resulting in a dry : wet ratio of 0.2

[b] Assumes that fish contain 75% moisture resulting in a dry : wet ratio of 0.25

[c] Bioaccumulation in aquatic organisms from URS (1996)

[d] Bionconcentration factor (wet weight) for PCB based on REEFEX fish see Table 6

[e] Saltwater continuous (chronic) concentrations (U.S. EPA 1998b, 1999b, summarized in Buchman 1999).

[f] Water benchmark set to Tier I Great Lakes Wildlife Criteria (USEPA 1995)

[g] Water benchmark set to Great Lakes Water Quality Criteria for Protection of Wildlife (USEPA 1995)

Table 9. Calculation of bioconcentration factor (BCF) for total PCB (tPCB) using the fraction of tPCB (f_{PCB}) present for each homologue group measured in fish from the ex-VERMILLION and reference reef (REEFEX Fish, Johnston et al. 2005).

A. Percent dry weight and lipid content from REEFEX fish

sample#	average
%dry	25.34
% lipid (wet weight)	3.51

B. Average fraction of homologues measured in 4 samples of Vermillion Snapper from DO26.

	fraction of Total PCB (f_{PCB})
sample#	average
Monochlorobiphenyls	0.000021
Dichlorobiphenyls	0.000480
Trichlorobiphenyls	0.007594
Tetrachlorobiphenyls	0.091651
Pentachlorobiphenyls	0.354637
Hexachlorobiphenyls	0.392479
Heptachlrobiphenyls	0.104417
Octachlorobiphenyls	0.040305
Nonachlorobiphenyls	0.007858
209 - Decachlorobiphenyl	0.000557
	1.000000

C. The weighted sum of the BCF was normalized to 3% lipid for aquatic organisms (US EPA 1994).

	a		-1.32		
	b		1		
Homologue	$\log(K_{ow})$[a]	f_{PCB}	$\log(BCF_{ww})$[b]	BCF_{ww}	$BCF_{ww}*f_{PCB}$
Monochlorobiphenyls	4.7	0.0000	3.38	2398.8	0.0
Dichlorobiphenyls	5.1	0.0005	3.78	6025.6	2.9
Trichlorobiphenyls	5.5	0.0076	4.18	15135.6	114.9
Tetrachlorobiphenyls	5.9	0.0917	4.58	38018.9	3484.5
Pentachlorobiphenyls	6.3	0.3546	4.98	95499.3	33867.6
Hexachlorobiphenyls	6.7	0.3925	5.38	239883.3	94149.3
Heptachlrobiphenyls	7.1	0.1044	5.78	602559.6	62917.7
Octachlorobiphenyls	7.5	0.0403	6.18	1513561.2	61004.3
BCF_{tPBC}					290270.4
		% Lipid	factor		
BCF_{tPBC} Normalized to 3% Lipid		3.51	0.8551		248208.8

[a] Mackay et al. 1992.

[b] wet weight; log(BCFww) = -1.32 + log(Kow) Mackay (1982) cited in Petersen and Kristensen (1998)

Table 10. Critical body burdens for (A) fish and (B) invertebrate no observed (adverse) effect dose (NOED, ug/g dry weight) obtained from US Army Corps of Engineers Environmental Residue-Effects Database (ERED).

(A) Fish Chemical	dry weight μg/g NOED	UF	dry weight mg/Kg $NOED_{ERED}$	wet weight mg/Kg $NOED_{ERED}$	ERED Citation
Total Polychorinated Biphenyls (tPCB)	6.00	1.00	6.00	1.50	NOED URS103 1975 Hansen, D.J., S.C. Schimmel and J. Forester Trans. Amer. Fish. Soc. 104:584-588. Sheepshead minnow
TEQ (dioxin toxicity equvalent)				5 pg TEQ/g Egg	Cook, P. M.; et al. 2003. *Environ. Sci. Technol.;* 3864-3877. Lake Trout Sac Fry mortality
TEQ (dioxin toxicity equvalent)				0.3 pg TEQ/g Roe (egg)	deBruyn, et al. 2004. Environ. Sci. Technol.; 2004; 38(23) pp 6217 - 6224; Mortality in salmon eqgs

(B) Invertebrate Chemical	NOED	UF	$NOED_{ERED}$	$NOED_{ERED}$	ERED Citation
Total Polychorinated Biphenyls (tPCB)	3.00	1.00	3.00	0.60	NOED URS223 1991 Velduizen-Tsoerkan, M.B., Holwerda, D.A., Zandee, D.I. Arch. Environ. Contam. Toxicol. 20: 259-265 Mussel

Table 11. Critical body burdens for (A) fish and (B) invertebrate lowest observed (adverse) effect dose (LOED, ug/g dry weight) obtained from US Army Corps of Engineers Environmental Residue-Effects Database (ERED).

(A) Fish

Chemical	dry weight μg/g LOED	UF	dry weight mg/Kg $LOED_{ERED}$	wet weight mg/Kg $LOED_{ERED}$	ERED Citation
Total Polychorinated Biphenyls (tPCB)	7.20	1.00	7.20	1.80	LOED URS173 1981 Mac, M.J. and J.G. Seelye Bull. Environ. Contam. Toxicol. 27:359-367. Trout -Lake
TEQ (dioxin toxicity equvalent)				30 pg TEQ/g Egg	Cook, P. M.; et al. 2003. *Environ. Sci. Technol.; 37* (17); 3864-3877. Lake Trout Sac Fry mortality
TEQ (dioxin toxicity equvalent)				3 pg TEQ/g lipid Roe(egg)	deBruyn, et al. 2004. Environ. Sci. Technol.; 2004; 38(23) pp 6217 - 6224; Mortality in salmon eqgs

(B) Invertebrate

Chemical	LOED	UF	$LOED_{ERED}$	$LOED_{ERED}$	ERED Citation
Total Polychorinated Biphenyls (tPCB)	5.50	1.00	5.5	1.10	ED10 URS102 1974 Hansen, D.J., P.R. Parrish and J. Forester Environ. Res. 7:363-373. Grass shrimp

Table 12. Calcuation of dietary benchmark for AVIAN CONSUMER herring gull — D_{Gull}. The dietary benchmarks were derived from literature toxicity reference values (TRV_{lit}) of similar avian species for herring gull (*Larus argentatus*) consumption of fish and

Omnivore - Herring Gull (HG) food injestion rate (g) = 264 R= 0.24
Herring Gull body weight bw (g) = 1100 a= 0.9
fish dry:wet = 0.25 L= 1.0
invert dry:wet = 0.2 d= 1.0

Chemical	Source of TRV	Literature TRV_{lit} $NOAEL_{lit}$ ug/g *bw*/day (wet weight)	UF	Herring Gull TRV_{HG} $NOAEL_{HG}$ ug/g *bw*/day (wet weight)	*F*	D_{Gull} wet ug/g (wet)	D_{Gull} fish[a] ug/g (dry)	D_{Gull} shellfish[b] ug/g (dry)
tPCB	Ring-neck pheasant NOAEL (Sample et al. 1996)	0.1800	1	0.18	0.2160	0.83	3.33	4.17
tPCB	Ring-neck pheasant **LOAEL** (Sample et al. 1996)	1.8000	1	1.80	0.2160	8.33	33.33	41.67
		pg/g bw/d	UF	pg/g *bw*/day (wet weight)	*F*	pg/g (wet)	pg/g (dry)	pg/g (dry)
[c] TEQ_{PCB}	Max concn. that can occur in diet without harmful effects to predator species (CCME 2003).					2.4	9.6	12.0
[d] TEQ	Ring-neck pheasant NOAEL (Nosek et al. 1992, cited in Weston Inc. 2003)	14	1	14	0.2160	64.8	259.3	324.1
[d] TEQ	Ring-neck pheasant **LOAEL** (Nosek et al. 1992, cited in Weston Inc. 2003)	140	1	140	0.2160	648.1	2592.6	3240.7
[d] TEQ	American kestral threshold for reproductive effects (Weston Inc. 2003)	25000	1	25000	0.2160	115740.7	462963.0	578703.7

[a] Assumes that fish contain 75% moisture resulting in a dry : wet ratio of 0.25
[b] Assumes that shellfish contain 80% moisture resulting in a dry : wet ratio of 0.2
[c] Total dioxin toxicity equivalent quotient TEQ = sum of toxicity equivalent concentration (TEC) for dioxin-like PCBs in pg/g diet.
[d] Total dioxin toxicity equivalent quotient TEQ = sum of toxicity equivalent concentration TEC for dioxin-like TCDDs, PCDFs, and PCBs

Table 13. Calcuation of dietary benchmark for AVIAN CONSUMER (cormorant) — $D_{\text{Comerant, based on}}$ benchmarks derived from literature toxicity reference values (TRV_{lit}) of similar avian species for double-crested cormorant (*Phalacrocorax auritus*) consumption

Piscivore (cormorant) food injestion rate (g) =	475
cormorant body weight bw (g) =	1900
fish dry:wet =	0.25
invert dry:wet =	0.2
R=	0.25
a=	0.9
L=	1.0
d=	1.0

Chemical	Source of TRV	Literature TRV_{lit} $NOAEL_{lit}$ ug/g *bw*/day (wet weight)	UF	Cormorant $TRV_{Cormorant}$ NOAELcomorant ug/g *bw*/day (wet weight)	*F*	**$D_{Cormorant}$** wet fish[a] ug/g (wet)	ug/g (dry)
tPCB	Aroclor Ring-neck pheasant NOAEL (Sample et al. 1996)	0.18	1	0.18	0.2250	0.80	3.20
tPCB	Aroclor Ring-neck pheasant **LOAEL** (Sample et al. 1996)	1.8	1	1.80	0.2250	8.00	32.00
		pg/g bw/d	UF	pg/g *bw*/day (wet weight)	*F*	pg/g (wet)	pg/g (dry)
[b] TEQ_{PCB}	Max concn. that can occur in diet without harmful effects to predator species (CCME 2003).					2.40	9.60
[c] TEQ	Ring-neck pheasant NOAEL (Nosek et al. 1992, cited in Weston Inc. 2003)	14	1	14	0.2250	62.2	248.9
[c] TEQ	Ring-neck pheasant **LOAEL** (Nosek et al. 1992, cited in Weston Inc. 2003)	140	1	140	0.2250	622.2	2488.9
[c] TEQ	American kestral threshold for reproductive effects (Weston Inc. 2003)	25000	1	25000	0.2250	111111.1	444444.4

[a] Assumes that fish contain 75% moisture resulting in a dry : wet ratio of 0.25

[b] Total dioxin toxicity equivalent quotient TEQ = sum of toxicity equivalent concentration (TEC) for dioxin-like PCBs in pg/g of diet.

[c] Total dioxin toxicity equivalent quotient TEQ = sum of toxicity equivalent concentration TEC for dioxin-like TCDDs, PCDFs, and PCBs

Table 14. Calcuation of dietary benchmark for TERTIARY CONSUMER (dolphin — $D_{Dolphin}$), based on literature toxicity reference values (TRV_{lit}) for mink (*Mustela vison*) to derive TRV for dolphin (*Tursiops truncatus*) consumption of fish and shellfish prey. Th

Dolphin food injestion rate (g) =	27000	R=	0.125581
Dolphin bw (g) =	215000	a=	0.9
fish dry:wet =	0.25	L=	1.0
invert dry:wet =	0.2	d=	1.0

Chemical	Source of TRV	Mink, *body weight (g)* 1000, TRV_{lit} $NOAEL_{lit}$ ug/g *bw*/day (wet weight)	UF	TRV Dolphin 215000 NOAEL NOAELlit*(bwtest/bwtarget)^.25 ug/g *bw*/day (wet weight)	*F*	$D_{Dolphin}$ wet ug/g (wet)	$D_{Dolphin}$ fish[a] ug/g (dry)	$D_{Dolphin}$ shellfish[b] ug/g (dry)
tPCB	Aroclor 1254 Mink NOAEL (Sample et al. 1996)	0.137	1	0.036	0.1130	0.32	1.27	1.58
tPCB	Aroclor 1254 Mink **LOAEL** (Sample et al. 1996)	0.685	1	0.179	0.1130	1.58	6.33	7.91
tPCB	Weathered PCBs feed to Mink NOAEL decrease in male kit bw (Halbrook et al. 1999)	0.120	1	0.031	0.1130	0.28	1.11	1.39
tPCB	Weathered PCBs feed to Mink **LOAEL** decrease in male kit bw (Halbrook et al. 1999)	0.230	1	0.060	0.1130	0.53	2.13	2.66
tPCB	Weathered PCBs feed to Mink NOAEL decreased kit survival (Bursian et al. 2003)	0.170	1	0.044	0.1130	0.39	1.57	1.96
tPCB	Weathered PCBs feed to Mink **LOAEL** decreased kit survival (Bursian et al. 2003)	0.410	1	0.107	0.1130	0.95	3.79	4.74
		pg/g bw/d	UF	pg/g *bw*/day (wet weight)	*F*	pg/g (wet)	pg/g (dry)	pg/g (dry)
[c] TEQ_{PCB}	Mammalian max concn. that can occur in diet without harmful effects to predator species (Environ. Canada 2004a).					0.79	3.16	3.95
[d] tTEQ	Weathered PCBs feed to Mink NOAEL decreased kit survival (Bursian et al. 2003)	1.70	1	0.44396	0.1130	3.93	15.71	19.64
[d] tTEQ	Weathered PCBs feed to Mink **LOAEL** decreased kit survival (Bursian et al. 2003)	7.70	1	2.01086	0.1130	17.79	71.17	88.96
[d] tTEQ	Decreased kit survivability NOEAL (Heaton et al. 1995)	1.10	1	0.28727	0.1130	2.54	10.17	12.71
[d] tTEQ	Decreased kit survivability **LOEAL** (Heaton et al. 1995)	4.50	1	1.17518	0.1130	10.40	41.59	51.99
[d] tTEQ	Mink NOEAL (Brunstrom et al. 2001)	0.35	1	0.09140	0.1130	0.81	3.23	4.04
[d] tTEQ	Mink **LOEAL** (Brunstrom et al. 2001)	2.40	1	0.62676	0.1130	5.55	22.18	27.73

[a] Assumes that fish contain 75% moisture resulting in a dry : wet ratio of 0.25

[b] Assumes that shellfish contain 80% moisture resulting in a dry : wet ratio of 0.2

[c] Total dioxin toxicity equivalent quotient TEQ = sum of toxicity equivalent concentration TEC for dioxin-like PCBs

Table 15a. Estimate of dietary benchmarks for loggerhead sea turtle — D_{Turtle} based on literature toxicity reference values (TRV_{lit}) for avian species and normalized to loggerhead (*Caretta caretta*) consumption rate 1450 g/day and body weight 113 kg (Seawo

Sea Turtle (loggerhead) food injestion rate (g) =	2421
sea turtle body weight bw (g) =	113000
fish dry:wet =	0.25
invert dry:wet =	0.2

R=	0.02142857
a=	0.9
L=	1.0
d=	1.0

Chemical	Source of TRV	Literature TRV_{lit} $NOAEL_{lit}$ ug/g *bw*/day (wet weight)	UF	Turtle TRV_{Turtle} NOAELcomorant ug/g *bw*/day (wet weight)	*F*	**D_{Turtle}** wet ug/g (wet)	fish[a] ug/g (dry)	invertebrate[b] ug/g (dry)
tPCB	Aroclor Ring-neck pheasant NOAEL (Sample et al. 1996)	0.18	1	0.18	0.0193	9.33	37.33	46.67
tPCB	Aroclor Ring-neck pheasant **LOAEL** (Sample et al. 1996)	1.8	1	1.80	0.0193	93.33	373.33	466.67
[c] TEQ_{PCB}	Avian max concn. that can occur without harmful effects to predator species (Environ. Canada 2004a).	0.0024	1	0.0024	0.0193	0.12444	0.49778	0.62

[a] Assumes that fish contain 75% moisture resulting in a dry : wet ratio of 0.25

[b] Assumes that invertebrate contain 80% moisture resulting in a dry : wet ratio of 0.2

[c] Total dioxin toxicity equivalent quotient TEQ = sum of toxicity equivalent concentration (TEC) for dioxin-like PCBs

Table 15b. Estimate of dietary benchmarks for loggerhead sea turtle — DTurtle based on literature toxicity reference values (TRVlit) for mink (*Mustela vison*) and normalized to loggerhead (Caretta caretta) consumption rate 1450 g/day and body weight 113 kg

food injestion rate (g/day) = 2421 — R= 0.02142857
sea turtle body weight bw (g) = 113000 — a= 0.9
fish dry:wet = 0.25 — L= 1.0
invert dry:wet = 0.2 — d= 1.0

Chemical	Source of TRV	Mink, body weight (g) 1000, TRV_{lit} $NOAEL_{lit}$ ug/g *bw* /day (wet weight)	UF	TRV Turtle, body weight (g) 113000, NOAEL NOAELlit*(bwtest/bwtarget)^.25 ug/g *bw* /day (wet weight)	*F*	D_{Turtle} wet ug/g (wet)	D_{Turtle} fish[a] ug/g (dry)	D_{Turtle} shellfish[b] ug/g (dry)
tPCB	Aroclor 1254 Mink NOAEL (Sample et al. 1996)	0.137	1	0.042	0.0193	2.18	8.72	10.89
tPCB	Aroclor 1254 Mink **LOAEL** (Sample et al. 1996)	0.685	1	0.210	0.0193	10.89	43.58	54.47
tPCB	Weathered PCBs feed to Mink NOAEL decrease in male kit bw (Halbrook et al. 1999)	0.120	1	0.037	0.0193	1.91	7.63	9.54
tPCB	Weathered PCBs feed to Mink **LOAEL** decrease in male kit bw (Halbrook et al. 1999)	0.230	1	0.071	0.0193	3.66	14.63	18.29
tPCB	Weathered PCBs feed to Mink NOAEL decreased kit survival (Bursian et al. 2003)	0.170	1	0.052	0.0193	2.70	10.81	13.52
tPCB	Weathered PCBs feed to Mink **LOAEL** decreased kit survival (Bursian et al. 2003)	0.410	1	0.126	0.0193	6.52	26.08	32.60
[c] tTEQ	Weathered PCBs feed to Mink NOAEL decreased kit survival (Bursian et al. 2003)	0.00170	1	0.00052	0.0193	0.0270	0.1081	0.1352
[c] tTEQ	Weathered PCBs feed to Mink **LOAEL** decreased kit survival (Bursian et al. 2003)	0.00770	1	0.00236	0.0193	0.1225	0.4898	0.6123
[c] tTEQ	Decreased kit survivability NOEAL (Heaton et al. 1995)	0.00110	1	0.00034	0.0193	0.0175	0.0700	0.0875
[c] tTEQ	Decreased kit survivability **LOEAL** (Heaton et al. 1995)	0.00450	1	0.00138	0.0193	0.0716	0.2863	0.3578
[c] tTEQ	Mink NOEAL (Brunstrom et al. 2001)	0.00035	1	0.00011	0.0193	0.0056	0.0223	0.0278
[c] tTEQ	Mink **LOEAL** (Brunstrom et al. 2001)	0.00240	1	0.00074	0.0193	0.0382	0.1527	0.1908
[d] TEQ_{PCB}	Mammal max concn. that can occur without harmful effects to predator species (Environ. Canada 2004a).	0.00079	1	0.00024	0.0193	0.0126	0.0503	0.0628

[a] Assumes that fish contain 75% moisture resulting in a dry : wet ratio of 0.25
[b] Assumes that shellfish contain 80% moisture resulting in a dry : wet ratio of 0.2
[c] Total dioxin toxicity equivalent quotient TEQ = sum of toxicity equivalent concentration TEC for dioxin-like TCDDs, PCDFs, and PCBs
[d] Total dioxin toxicity equivalent quotient TEQ = sum of toxicity equivalent concentration TEC for dioxin-like PCBs

Table 15c. Dietary benchmarks for loggerhead sea turtle (D_{Turtle}) based on the lowest value between TRVs based on avian or mammalian literature toxicity reference values.

		D_{Turtle}			
Chemical	Source of TRV	wet ug/g (wet)	fish[a] ug/g (dry)	invertebrate[b] ug/g (dry)	Factor[c] Difference
tPCB	Aroclor 1254 Mink NOAEL (Sample et al. 1996)	2.179	8.715	10.894	4.28
tPCB	Aroclor 1254 Mink LOAEL (Sample et al. 1996)	10.894	43.576	54.470	8.57
tPCB	Weathered PCBs feed to Mink NOAEL decrease in male kit bw (Halbrook et al. 1999)	1.908	7.634	9.542	
tPCB	Weathered PCBs feed to Mink LOAEL decrease in male kit bw (Halbrook et al. 1999)	3.658	14.631	18.289	
tPCB	Weathered PCBs feed to Mink NOAEL decreased kit survival (Bursian et al. 2003)	2.704	10.814	13.518	
tPCB	Weathered PCBs feed to Mink LOAEL decreased kit survival (Bursian et al. 2003)	6.520	26.082	32.602	
[d] tTEQ	Weathered PCBs feed to Mink NOAEL decreased kit survival (Bursian et al. 2003)	0.027	0.108	0.135	
[d] tTEQ	Weathered PCBs feed to Mink LOAEL decreased kit survival (Bursian et al. 2003)	0.122	0.490	0.612	
[d] tTEQ	Decreased kit survivability NOEAL (Heaton et al. 1995)	0.017	0.070	0.087	
[d] tTEQ	Decreased kit survivability LOEAL (Heaton et al. 1995)	0.072	0.286	0.358	
[d] tTEQ	Mink NOEAL (Brunstrom et al. 2001)	0.006	0.022	0.028	
[d] tTEQ	Mink LOEAL (Brunstrom et al. 2001)	0.038	0.153	0.191	
[e] TEQPCB	Mammal max concn. that can occur without harmful effects to predator species (Environ. Canada 2004a).	0.013	0.050	0.063	0.10

[a] Assumes that fish contain 75% moisture resulting in a dry : wet ratio of 0.25

[b] Assumes that shellfish contain 80% moisture resulting in a dry : wet ratio of 0.2

[c] Factor difference between turtle benchmark based on mammalian TRV compared to avian TRV (mammal/avian)

[d] Total dioxin toxicity equivalent quotient TEQ = sum of toxicity equivalent concentration TEC for dioxin-like TCDDs, PCDFs, and PCBs

[e] Total dioxin toxicity equivalent quotient TEQ = sum of toxicity equivalent concentration TEC for dioxin-like PCBs

Table 16. Calculation of dietary PCB benchmark for shark/barracuda based on ratio of food chain multipliers (FCM) between trophic level IV (TL-IV shark - FCM4) and Trophic Level III (TL-III prey - FCM3) obtained from USEPA (2000) and weighted by the fraction of PCB homologs (f_{PCB}) observed in REEFEX fish.

Homologue	Log(Kow)[a]	f_{PCB}[b]	Reef Forager (TL-III) FCM3[c]	Reef Predator (TL-IV) FCM4[d]	ratio FCM4/ FCM3[e]	wFCM[f]	$wFCM_{TPCB}$[g]
Monochlorobiphenyls	4.5	0.0000	1.70	1.32	0.78	0.00002	
Dichlorobiphenyls	5.2	0.0005	3.93	3.68	0.94	0.00045	
Trichlorobiphenyls	5.5	0.0076	5.85	6.65	1.14	0.00863	
Tetrachlorobiphenyls	5.9	0.0917	9.01	13.00	1.44	0.13224	
Pentachlorobiphenyls	6.5	0.3546	12.60	22.80	1.81	0.64172	
Hexachlorobiphenyls	7.0	0.3925	13.20	24.30	1.84	0.72252	
Heptachlrobiphenyls	7.2	0.1044	12.80	22.50	1.76	0.18355	
Octachlorobiphenyls	7.7	0.0403	10.10	13.30	1.32	0.05308	
Nonachlorobiphenyls	8.4	0.0079	4.33	2.20	0.51	0.00399	
209 - Decachlorobiphenyl[h]	9.6	0.0006	1.38	0.21	0.15	0.00008	
homolog average rFCM		1.0000			1.17		
TPCB	6.7	1.0000	13.20	24.40	1.85		
weighted food chain multiplier for TPCB							1.75

Enpoint	Source	ug/g wet	ratio $wFCM_{TPCB}$	D_{Shark} prey (fish) mg/kg wet	D_{Shark} prey (fish) ug/g dry
NOED	Westin et al. 1983, striped bass	4.4	1.75	2.520	10.079
LOED	Black et al. 1988, winter flounder	7.1	1.75	4.066	16.263

[a] Log(Kow) used in PRAM 1.4a (URS 2005a)

[b] fraction of tPCB (f_{PCB}) measured in representative samples of reefex fish (see Table 9)

[c] food chain multiplier (FCM3) obtained from Trophic Level - III prey (USEPA 2000)

[d] food chain multiplier (FCM4) obtained from Trophic Level - III predator (USEPA 2000)

[e] ratio of FCM4/FCM3

[f] weighted food chain multiplier for each homolog group (wFCM)

[g] weighted food chain multiplier for TPCB ($wFCM_{TPBC}$) .

[h] estimated using FCM for Kow=9.0

Table 17. Coplanar dixon-like PCB congeners and Toxicity Equivalent Factors (TEF) for mammals, birds, and fish.

		Ahlborg et al. 1994	Van den Berg et al. 1998*			Cook et al. 2003
Homolog	congener	All Species	Mammal_TEF	Bird_TEF	Fish_TEF	Fish
Tetrachlorobiphenyl	PCB077	0.0005	0.0001	0.05	0.0001	0.00016
Tetrachlorobiphenyl	PCB081		0.0001	0.1	0.0005	0.00056
Pentachlorobiphenyl	PCB105	0.0001	0.0001	0.0001	0.000005	0.000005
Pentachlorobiphenyl	PCB114	0.0005	0.0005	0.0001	0.000005	
Pentachlorobiphenyl	PCB118	0.0001	0.0001	0.00001	0.000005	0.000005
Pentachlorobiphenyl	PCB123	0.0001	0.0001	0.00001	0.000005	
Pentachlorobiphenyl	PCB126	0.1	0.1	0.1	0.005	0.005
Hexachlorobiphenyl	PCB156	0.0005	0.0005	0.0001	0.000005	0.000005
Hexachlorobiphenyl	PCB157	0.0005	0.0005	0.0001	0.000005	
Hexachlorobiphenyl	PCB167	0.00001	0.00001	0.00001	0.000005	
Hexachlorobiphenyl	PCB169	0.01	0.01	0.001	0.00005	0.01
Heptachlorobiphenyl	PCB170a	0.0001	0.0001	0.00001	0.000005	
Heptachlorobiphenyl	PCB180a	0.00001	0.0001	0.00001	0.000005	
Heptachlorobiphenyl	PCB189	0.0001	0.0001	0.00001	0.000005	

*TEFs used in this report (see http://www.epa.gov/toxteam/pcbid/tefs.htm)

a shaded TEFs are assumed to be equal to PCB189

Table 18. (A) The total mass and the fraction of homolog that was composed of dioxin-like PCB congeners released during the leachrate experiments normalized to the mass of shipboard solids containing PCBs onboard the ex-ORISKANY.
(B) The observed time series of PCBs released from materials tested in the leachrate study that are expected to be on the ex-ORISKANY.

A. Total PCBs released from all materials

	Cl1	Cl2	PCB8	Cl3	PCB18	PCB28	Cl4	PCB44	PCB49	PCB52	PCB66	PCB077	Cl5	PCB87
Sum Mass Released by Analyte (g PCB)	9.30E-03	2.01E+00	2.06E-01	6.98E+00	5.73E-01	2.18E+00	1.87E+02	3.09E+01	9.61E+00	5.32E+01	8.87E+00	6.29E-02	3.72E+02	2.80E+01
Dioxin-like Congeners: Fraction of Homolog												3.36E-04		

B. Time series of PCBs released from materials expected to be on the ex-ORISKANY

Paints — ex-Oriskany 95% UCL Total Vessel Mass Release (g PCB)

Leaching Time (days)	Cl1	Cl2	PCB8	Cl3	PCB18	PCB28	Cl4	PCB44	PCB49	PCB52	PCB66	PCB77	Cl5	PCB87
0.008	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7.022	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.33E-02	0.00E+00	7.93E-03	1.05E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
21.076	0.00E+00	0.00E+00	0.00E+00	2.84E-02	0.00E+00	4.60E-03	1.11E-01	1.22E-02	8.38E-03	1.76E-02	0.00E+00	0.00E+00	2.43E-01	1.24E-02
42.044	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.87E-02	0.00E+00	0.00E+00	2.30E-02	0.00E+00	0.00E+00	3.11E-01	1.35E-02
71.241	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.15E-02	1.70E-02	6.93E-03	2.75E-02	0.00E+00	0.00E+00	3.92E-01	2.09E-02
105.081	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.48E-02	0.00E+00	0.00E+00	2.60E-02	0.00E+00	0.00E+00	3.01E-01	2.19E-02
147.088	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.78E-01	2.19E-02	8.20E-03	3.55E-02	0.00E+00	0.00E+00	5.88E-01	2.60E-02
189.030	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.49E-01	1.76E-02	0.00E+00	3.25E-02	0.00E+00	0.00E+00	4.46E-01	2.30E-02
231.006	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.20E-02	0.00E+00	0.00E+00	3.65E-02	0.00E+00	0.00E+00	3.92E-01	0.00E+00
273.125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.14E-02	0.00E+00	0.00E+00	3.28E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
315.042	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-02	0.00E+00	0.00E+00	2.87E-02	0.00E+00	0.00E+00	2.19E-02	0.00E+00
357.008	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.24E-01	2.05E-02	0.00E+00	4.24E-02	0.00E+00	0.00E+00	5.06E-01	0.00E+00
399.022	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.69E-02	0.00E+00	0.00E+00	3.01E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
469.032	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E-02	1.78E-02	0.00E+00	2.32E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Bulkhead Insulation — ex-Oriskany 95% UCL Total Vessel Mass Release (g PCB)

Leaching Time (days)	Cl1	Cl2	PCB8	Cl3	PCB18	PCB28	Cl4	PCB44	PCB49	PCB52	PCB66	PCB77	Cl5	PCB87
0.007	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.170	0.00E+00	0.00E+00	0.00E+00	2.38E-02	0.00E+00	1.64E-02	5.57E-01	6.50E-02	2.75E-02	1.08E-01	1.33E-02	0.00E+00	5.26E-01	0.00E+00
7.076	0.00E+00	2.72E-01	3.06E-02	3.75E-01	4.07E-02	1.03E-01	4.69E+00	7.82E-01	2.56E-01	1.22E+00	2.35E-01	0.00E+00	4.38E+00	3.75E-01
14.083	0.00E+00	4.43E-01	2.94E-02	3.79E-01	4.74E-02	1.26E-01	7.27E+00	1.17E+00	3.79E-01	1.86E+00	3.16E-01	1.33E-02	7.90E+00	6.32E-01
21.097	0.00E+00	2.15E-02	2.12E-02	3.48E-01	3.48E-02	1.17E-01	8.53E+00	1.33E+00	4.43E-01	2.09E+00	5.06E-01	0.00E+00	1.55E+01	1.14E+00
42.226	0.00E+00	3.16E-02	3.16E-02	5.37E-01	6.64E-02	1.96E-01	1.20E+01	2.05E+00	6.64E-01	3.16E+00	6.32E-01	0.00E+00	1.80E+01	1.52E+00
69.301	0.00E+00	2.87E-02	2.75E-02	5.99E-01	2.75E-02	1.92E-01	2.03E+01	2.72E+00	8.08E-01	4.19E+00	9.58E-01	0.00E+00	4.79E+01	2.99E+00
83.139	0.00E+00	0.00E+00	0.00E+00	3.75E-01	4.07E-02	1.56E-01	1.13E+01	2.00E+00	6.57E-01	3.13E+00	6.88E-01	0.00E+00	2.85E+01	2.16E+00
118.135	0.00E+00	2.47E-02	2.47E-02	5.63E-01	6.25E-02	2.13E-01	1.44E+01	2.69E+00	8.76E-01	4.38E+00	6.57E-01	2.56E-02	2.78E+01	2.31E+00
167.104	0.00E+00	2.35E-02	2.29E-02	5.57E-01	6.19E-02	2.26E-01	2.69E+01	3.71E+00	1.11E+00	6.19E+00	1.36E+00	0.00E+00	7.42E+01	4.33E+00
209.131	0.00E+00	1.63E-02	1.63E-02	4.38E-01	4.38E-02	1.56E-01	1.25E+01	2.35E+00	7.51E-01	4.07E+00	7.51E-01	0.00E+00	2.56E+01	2.50E+00
251.192	0.00E+00	0.00E+00	0.00E+00	4.95E-01	5.88E-02	1.61E-01	1.48E+01	2.69E+00	7.73E-01	4.95E+00	8.66E-01	0.00E+00	3.09E+01	2.32E+00
286.150	0.00E+00	0.00E+00	0.00E+00	3.09E-01	0.00E+00	1.18E-01	1.05E+01	1.76E+00	5.88E-01	3.09E+00	3.71E-01	0.00E+00	1.52E+01	1.67E+00
328.092	0.00E+00	0.00E+00	0.00E+00	3.71E-01	3.71E-02	8.66E-02	8.66E+00	1.76E+00	4.95E-01	3.09E+00	3.71E-01	0.00E+00	1.79E+01	1.45E+00
370.117	0.00E+00	0.00E+00	0.00E+00	4.02E-01	4.33E-02	1.24E-01	1.02E+01	1.86E+00	6.19E-01	3.71E+00	4.02E-01	0.00E+00	1.55E+01	1.61E+00
398.079	0.00E+00	0.00E+00	0.00E+00	5.32E-01	0.00E+00	7.51E-02	8.13E+00	1.44E+00	3.75E-01	2.72E+00	2.88E-01	0.00E+00	1.44E+01	1.16E+00
454.319	0.00E+00	0.00E+00	0.00E+00	5.94E-01	0.00E+00	8.13E-02	7.19E+00	1.22E+00	3.75E-01	2.28E+00	2.25E-01	0.00E+00	1.22E+01	1.03E+00

Table 18. Cont.

Rubber Products — ex-Oriskany 95% UCL Total Vessel Mass Release (g PCB)

Leaching Time (days)	Cl1	Cl2	PCB8	Cl3	PCB18	PCB28	Cl4	PCB44	PCB49	PCB52	PCB66	PCB77	Cl5	PCB87
0.006	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.169	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7.074	3.10E-04	8.46E-04	4.17E-05	3.55E-04	5.53E-05	7.89E-05	1.24E-03	1.69E-04	1.02E-04	3.21E-04	1.97E-05	0.00E+00	1.02E-03	0.00E+00
14.081	0.00E+00	2.54E-03	5.65E-05	4.78E-04	6.91E-05	1.04E-04	1.84E-03	3.28E-04	1.56E-04	6.34E-04	4.72E-05	0.00E+00	9.22E-04	5.01E-05
28.153	4.78E-04	6.34E-04	6.34E-05	5.76E-04	6.91E-05	1.04E-04	2.77E-03	4.44E-04	1.73E-04	9.22E-04	6.34E-05	0.00E+00	2.30E-03	1.04E-04
49.204	5.59E-04	9.12E-05	9.12E-05	4.67E-04	1.14E-04	2.05E-04	3.93E-03	6.27E-04	2.62E-04	1.25E-03	1.08E-04	0.00E+00	2.28E-03	1.48E-04
69.272	0.00E+00	8.18E-05	7.64E-05	6.55E-04	8.73E-05	1.42E-04	5.13E-03	6.55E-04	2.51E-04	1.31E-03	1.31E-04	0.00E+00	3.66E-03	2.29E-04
104.181	7.98E-04	9.69E-04	1.08E-04	7.98E-04	1.60E-04	1.88E-04	4.85E-03	7.98E-04	3.31E-04	1.54E-03	1.71E-04	0.00E+00	4.56E-03	2.34E-04
146.122	8.07E-04	1.09E-03	1.21E-04	1.21E-03	1.44E-04	4.72E-04	4.96E-03	8.07E-04	3.00E-04	1.56E-03	1.33E-04	0.00E+00	4.96E-03	2.48E-04
188.072	6.84E-04	6.84E-04	7.98E-05	7.41E-04	1.03E-04	1.25E-04	3.53E-03	6.27E-04	2.28E-04	1.20E-03	8.55E-05	0.00E+00	2.96E-03	1.60E-04
230.109	6.20E-04	7.33E-05	7.33E-05	2.59E-03	1.18E-04	3.21E-04	3.27E-03	5.13E-04	1.69E-04	1.07E-03	1.13E-04	0.00E+00	2.99E-03	1.47E-04
286.142	1.02E-03	1.18E-04	1.07E-04	2.59E-03	1.13E-04	0.00E+00	2.20E-03	4.12E-04	1.30E-04	9.02E-04	2.31E-05	0.00E+00	8.46E-04	0.00E+00
328.083	6.84E-04	4.16E-04	7.41E-05	3.93E-04	9.69E-05	0.00E+00	2.17E-03	4.28E-04	1.20E-04	9.12E-04	3.42E-05	0.00E+00	1.54E-03	7.98E-05
370.110	6.84E-04	6.27E-04	9.12E-05	5.47E-04	1.03E-04	1.08E-04	2.45E-03	4.22E-04	1.54E-04	8.55E-04	5.70E-05	0.00E+00	1.31E-03	1.03E-04
398.072	4.05E-04	9.12E-04	7.41E-05	6.84E-04	1.20E-04	7.41E-05	2.17E-03	3.99E-04	1.31E-04	7.98E-04	9.12E-05	0.00E+00	1.77E-03	0.00E+00
475.124	9.69E-04	7.41E-04	1.20E-04	1.25E-03	1.60E-04	0.00E+00	3.59E-03	5.64E-04	1.71E-04	1.14E-03	6.84E-05	0.00E+00	2.45E-03	0.00E+00

Cable Insulation — ex-Oriskany 95% UCL Total Vessel Mass Release (g PCB)

Leaching Time (days)	Cl1	Cl2	PCB8	Cl3	PCB18	PCB28	Cl4	PCB44	PCB49	PCB52	PCB66	PCB77	Cl5	PCB87
0.003	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.077	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6.009	0.00E+00	7.60E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.33E-01	2.75E-02	1.54E-02	4.85E-02	0.00E+00	0.00E+00	2.75E-01	0.00E+00
20.035	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.92E-01	6.74E-02	2.66E-02	1.32E-01	1.30E-02	0.00E+00	5.01E-01	2.98E-02
40.989	0.00E+00	9.50E-02	0.00E+00	9.82E-03	6.49E-03	0.00E+00	6.18E-01	8.08E-02	3.01E-02	1.58E-01	1.90E-02	0.00E+00	1.01E+00	4.59E-02
62.235	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.91E-01	9.66E-02	2.85E-02	1.74E-01	2.22E-02	0.00E+00	9.66E-01	5.86E-02
90.010	0.00E+00	2.81E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.33E-01	8.88E-02	2.81E-02	1.63E-01	1.10E-02	0.00E+00	9.33E-01	5.48E-02
125.028	0.00E+00	0.00E+00	0.00E+00	3.04E-02	0.00E+00	2.40E-02	6.40E-01	1.02E-01	3.04E-02	2.24E-01	1.60E-02	2.40E-02	1.07E+00	7.52E-02
166.998	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.88E-01	1.06E-01	2.72E-02	2.08E-01	2.40E-02	0.00E+00	1.41E+00	6.72E-02
208.968	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.29E-01	9.74E-02	3.56E-02	2.14E-01	2.73E-02	0.00E+00	1.43E+00	5.23E-02
250.982	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.18E-01	8.87E-02	3.17E-02	1.90E-01	1.90E-02	0.00E+00	8.39E-01	6.02E-02
300.024	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.54E-01	6.81E-02	0.00E+00	1.74E-01	1.41E-02	0.00E+00	3.48E-01	0.00E+00
341.964	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.23E-01	8.23E-02	2.06E-02	1.90E-01	1.74E-02	0.00E+00	7.92E-01	5.07E-02
383.993	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.16E-01	1.22E-01	4.32E-02	2.88E-01	2.56E-02	0.00E+00	1.02E+00	1.06E-01
411.955	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.36E-01	8.80E-02	2.88E-02	1.92E-01	2.56E-02	0.00E+00	1.17E+00	7.36E-02
474.981	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.08E-01	7.84E-02	3.20E-02	1.76E-01	0.00E+00	0.00E+00	6.72E-01	3.68E-02

Vent. Gaskets — ex-Oriskany 95% UCL Total Vessel Mass Release (g PCB)

Leaching Time (days)	Cl1	Cl2	PCB8	Cl3	PCB18	PCB28	Cl4	PCB44	PCB49	PCB52	PCB66	PCB77	Cl5	PCB87
0.006	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.169	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7.074	4.98E-05	1.36E-04	6.70E-06	5.70E-05	8.87E-06	1.27E-05	1.99E-04	2.71E-05	1.63E-05	5.16E-05	3.17E-06	0.00E+00	1.63E-04	0.00E+00
14.081	0.00E+00	4.07E-04	9.06E-06	7.67E-05	1.11E-05	1.66E-05	2.96E-04	5.27E-05	2.50E-05	1.02E-04	7.58E-06	0.00E+00	1.48E-04	8.04E-06
28.153	7.67E-05	1.02E-04	1.02E-05	9.24E-05	1.11E-05	1.66E-05	4.44E-04	7.12E-05	2.77E-05	1.48E-04	1.02E-05	0.00E+00	3.70E-04	1.66E-05
49.204	8.96E-05	1.46E-05	1.46E-05	7.50E-05	1.83E-05	3.29E-05	6.31E-04	1.01E-04	4.21E-05	2.01E-04	1.74E-05	0.00E+00	3.66E-04	2.38E-05
69.272	0.00E+00	1.31E-05	1.23E-05	1.05E-04	1.40E-05	2.28E-05	8.23E-04	1.05E-04	4.03E-05	2.10E-04	2.10E-05	0.00E+00	5.86E-04	3.68E-05
104.181	1.28E-04	1.55E-04	1.74E-05	1.28E-04	2.56E-05	3.02E-05	7.77E-04	1.28E-04	5.30E-05	2.47E-04	2.74E-05	0.00E+00	7.32E-04	3.75E-05
146.122	1.29E-04	1.76E-04	1.94E-05	1.94E-04	2.31E-05	7.58E-05	7.95E-04	1.29E-04	4.81E-05	2.50E-04	2.13E-05	0.00E+00	7.95E-04	3.98E-05
188.072	1.10E-04	1.10E-04	1.28E-05	1.19E-04	1.65E-05	2.01E-05	5.67E-04	1.01E-04	3.66E-05	1.92E-04	1.37E-05	0.00E+00	4.76E-04	2.56E-05
230.109	9.95E-05	1.18E-05	1.18E-05	4.16E-04	1.90E-05	5.16E-05	5.25E-04	8.23E-05	2.71E-05	1.72E-04	1.81E-05	0.00E+00	4.80E-04	2.35E-05
286.142	1.63E-04	1.90E-05	1.72E-05	4.16E-04	1.81E-05	0.00E+00	3.53E-04	6.60E-05	2.08E-05	1.45E-04	3.71E-06	0.00E+00	1.36E-04	0.00E+00
328.083	1.10E-04	6.68E-05	1.19E-05	6.31E-05	1.55E-05	0.00E+00	3.48E-04	6.86E-05	1.92E-05	1.46E-04	5.49E-06	0.00E+00	2.47E-04	1.28E-05
370.110	1.10E-04	1.01E-04	1.46E-05	8.78E-05	1.65E-05	1.74E-05	3.93E-04	6.77E-05	2.47E-05	1.37E-04	9.15E-06	0.00E+00	2.10E-04	1.65E-05
398.072	6.49E-05	1.46E-04	1.19E-05	1.10E-04	1.92E-05	1.19E-05	3.48E-04	6.40E-05	2.10E-05	1.28E-04	1.46E-05	0.00E+00	2.84E-04	0.00E+00
475.124	1.55E-04	1.19E-04	1.92E-05	2.01E-04	2.56E-05	0.00E+00	5.76E-04	9.05E-05	2.74E-05	1.83E-04	1.10E-05	0.00E+00	3.93E-04	0.00E+00

Table 18. Cont.

A. Total PCBs released fr

	PCB101	PCB105	PCB114	PCB118	PCB123	PCB126	Cl6	PCB128	PCB138	PCB153	PCB156	PCB157	PCB167	PCB169	Cl7
Sum Mass Released by Analyte (g PCB)	4.41E+01	1.04E+01	3.62E-01	2.37E+01	0.00E+00	0.00E+00	8.09E+01	2.37E+00	1.09E+01	8.79E+00	6.29E-01	2.63E-02	9.63E-02	0.00E+00	3.71E+00
Dioxin-like Congeners: Fraction of Homolog		2.79E-02	9.72E-04	6.36E-02	0.00E+00	0.00E+00					7.78E-03	3.25E-04	1.19E-03	0.00E+00	

B. Time series of PCBs re

Paints

Leaching Time (days)	PCB101	PCB105	PCB114	PCB118	PCB123	PCB126	Cl6	PCB128	PCB138	PCB153	PCB156	PCB157	PCB167	PCB169	Cl7
0.008	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.08E-02
7.022	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.02E-02
21.076	2.16E-02	6.49E-03	0.00E+00	1.04E-02	0.00E+00	0.00E+00	1.20E-01	0.00E+00	8.52E-03	1.33E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-01
42.044	2.30E-02	8.25E-03	0.00E+00	1.76E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
71.241	3.53E-02	0.00E+00	0.00E+00	2.22E-02	0.00E+00	0.00E+00	3.01E-01	0.00E+00	1.96E-02	1.57E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
105.081	3.83E-02	0.00E+00	0.00E+00	3.28E-02	0.00E+00	0.00E+00	2.19E-01	0.00E+00	3.28E-02	3.28E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
147.088	4.10E-02	1.50E-02	0.00E+00	3.01E-02	0.00E+00	0.00E+00	3.83E-01	0.00E+00	2.60E-02	3.96E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
189.030	3.38E-02	1.15E-02	0.00E+00	2.70E-02	0.00E+00	0.00E+00	2.57E-01	0.00E+00	2.03E-02	3.11E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
231.006	4.46E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
273.125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
315.042	2.05E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
357.008	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
399.022	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
469.032	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Bulkhead Insulation

Leaching Time (days)	PCB101	PCB105	PCB114	PCB118	PCB123	PCB126	Cl6	PCB128	PCB138	PCB153	PCB156	PCB157	PCB167	PCB169	Cl7
0.007	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.170	2.26E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.09E-01
7.076	5.00E-01	1.16E-01	0.00E+00	2.41E-01	0.00E+00	0.00E+00	7.19E-01	0.00E+00	5.94E-02	3.44E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.69E-01
14.083	1.04E+00	2.21E-01	0.00E+00	5.37E-01	0.00E+00	0.00E+00	8.85E-01	4.43E-02	1.20E-01	7.90E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.99E-01
21.097	1.80E+00	4.43E-01	2.88E-02	1.07E+00	0.00E+00	0.00E+00	2.28E+00	7.59E-02	2.97E-01	1.58E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
42.226	2.50E+00	6.01E-01	3.79E-02	1.52E+00	0.00E+00	0.00E+00	2.81E+00	1.39E-01	4.43E-01	6.01E-01	4.43E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
69.301	4.79E+00	1.50E+00	8.98E-02	3.29E+00	0.00E+00	0.00E+00	1.11E+01	4.19E-01	1.47E+00	6.28E-01	1.50E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
83.139	3.44E+00	1.00E+00	5.63E-02	2.38E+00	0.00E+00	0.00E+00	5.00E+00	2.38E-01	9.38E-01	5.94E-01	6.88E-02	0.00E+00	0.00E+00	0.00E+00	4.69E-01
118.135	3.75E+00	1.06E+00	0.00E+00	2.47E+00	0.00E+00	0.00E+00	5.63E+00	2.47E-01	9.69E-01	5.32E-01	8.44E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
167.104	7.42E+00	2.04E+00	9.59E-02	5.26E+00	0.00E+00	0.00E+00	1.89E+01	4.95E-01	2.41E+00	1.30E+00	2.01E-01	0.00E+00	6.19E-02	0.00E+00	1.39E+00
209.131	3.75E+00	1.13E+00	5.32E-02	2.25E+00	0.00E+00	0.00E+00	5.94E+00	2.69E-01	1.09E+00	1.22E+00	8.13E-02	2.63E-02	3.44E-02	0.00E+00	5.94E-01
251.192	3.40E+00	6.19E-01	0.00E+00	1.33E+00	0.00E+00	0.00E+00	6.19E+00	1.73E-01	7.42E-01	8.35E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
286.150	2.38E+00	4.64E-01	0.00E+00	8.97E-01	0.00E+00	0.00E+00	2.41E+00	0.00E+00	5.88E-01	8.35E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
328.092	2.13E+00	3.40E-01	0.00E+00	6.50E-01	0.00E+00	0.00E+00	4.33E+00	1.36E-01	4.95E-01	5.26E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
370.117	2.38E+00	2.54E-01	0.00E+00	4.64E-01	0.00E+00	0.00E+00	3.09E+00	9.90E-02	3.40E-01	4.64E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
398.079	1.75E+00	2.03E-01	0.00E+00	3.13E-01	0.00E+00	0.00E+00	4.07E+00	0.00E+00	4.07E-01	3.75E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
454.319	1.47E+00	1.28E-01	0.00E+00	2.00E-01	0.00E+00	0.00E+00	4.07E+00	0.00E+00	2.47E-01	3.03E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Talbe 18. Cont.

Rubber Products

Leaching Time (days)	PCB101	PCB105	PCB114	PCB118	PCB123	PCB126	Cl6	PCB128	PCB138	PCB153	PCB156	PCB157	PCB167	PCB169	Cl7
0.006	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.99E-04
1.169	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.76E-04
7.074	3.55E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.24E-04
14.081	1.04E-04	0.00E+00	0.00E+00	2.94E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.44E-04
28.153	2.25E-04	0.00E+00	0.00E+00	9.80E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
49.204	2.79E-04	4.50E-05	0.00E+00	1.43E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
69.272	3.93E-04	8.73E-05	0.00E+00	2.51E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
104.181	4.56E-04	0.00E+00	0.00E+00	2.68E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
146.122	4.32E-04	1.15E-04	0.00E+00	2.65E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
188.072	2.68E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
230.109	2.59E-04	0.00E+00	0.00E+00	1.07E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
286.142	1.18E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
328.083	1.43E-04	3.08E-05	0.00E+00	5.47E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
370.110	1.37E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
398.072	7.98E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
475.124	1.43E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Cable Insulation

Leaching Time (days)	PCB101	PCB105	PCB114	PCB118	PCB123	PCB126	Cl6	PCB128	PCB138	PCB153	PCB156	PCB157	PCB167	PCB169	Cl7
0.003	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.077	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6.009	1.42E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.50E-02
20.035	5.17E-02	1.33E-02	0.00E+00	2.82E-02	0.00E+00	0.00E+00	4.23E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.39E-01
40.989	8.55E-02	2.06E-02	0.00E+00	5.70E-02	0.00E+00	0.00E+00	2.53E-01	0.00E+00	1.20E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
62.235	1.05E-01	2.53E-02	0.00E+00	6.97E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
90.010	1.04E-01	2.52E-02	0.00E+00	7.85E-02	0.00E+00	0.00E+00	3.26E-01	0.00E+00	3.26E-02	2.81E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.22E-02
125.028	1.54E-01	4.80E-02	0.00E+00	1.04E-01	0.00E+00	0.00E+00	6.40E-01	3.68E-02	4.16E-02	4.80E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
166.998	1.12E-01	2.40E-02	0.00E+00	7.04E-02	0.00E+00	0.00E+00	4.48E-01	0.00E+00	2.56E-02	4.32E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
208.968	9.03E-02	0.00E+00	0.00E+00	4.16E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
250.982	8.55E-02	2.22E-02	0.00E+00	4.59E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
300.024	5.86E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
341.964	8.23E-02	1.74E-02	0.00E+00	3.80E-02	0.00E+00	0.00E+00	1.90E-01	0.00E+00	1.90E-02	1.74E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
383.993	1.60E-01	4.16E-02	0.00E+00	7.84E-02	0.00E+00	0.00E+00	3.20E-01	0.00E+00	4.64E-02	4.16E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
411.955	8.64E-02	0.00E+00	0.00E+00	3.36E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
474.981	6.08E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Vent. Gaskets

Leaching Time (days)	PCB101	PCB105	PCB114	PCB118	PCB123	PCB126	Cl6	PCB128	PCB138	PCB153	PCB156	PCB157	PCB167	PCB169	Cl7
0.006	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.80E-05
1.169	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.43E-05
7.074	5.70E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.41E-05
14.081	1.66E-05	0.00E+00	0.00E+00	4.71E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.12E-05
28.153	3.61E-05	0.00E+00	0.00E+00	1.57E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
49.204	4.48E-05	7.23E-06	0.00E+00	2.29E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
69.272	6.30E-05	1.40E-05	0.00E+00	4.03E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
104.181	7.32E-05	0.00E+00	0.00E+00	4.30E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
146.122	6.93E-05	1.85E-05	0.00E+00	4.25E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
188.072	4.30E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
230.109	4.16E-05	0.00E+00	0.00E+00	1.72E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
286.142	1.90E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
328.083	2.29E-05	4.94E-06	0.00E+00	8.78E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
370.110	2.20E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
398.072	1.28E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
475.124	2.29E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 18 Cont.

A. Total PCBs released fr

	PCB170	PCB180	PCB183	PCB184	PCB187	PCB189	Cl8	PCB195	Cl9	PCB206	Cl10	PCB209	tPCBs
Sum Mass Released by Analyte (g PCB)	7.73E-02	1.43E-01	7.95E-02	1.63E-01	1.53E-01	0.00E+00	0.00E+00	0.00E+00	4.00E-02	2.56E-02	2.24E-02	2.24E-02	6.53E+02
Dioxin-like Congeners: Fraction of Homolog	2.08E-02	3.85E-02				0.00E+00							

B. Time series of PCBs re

Paints

Leaching Time (days)	PCB170	PCB180	PCB183	PCB184	PCB187	PCB189	Cl8	PCB195	Cl9	PCB206	Cl10	PCB209	tPCBs
0.008	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.101	0.00E+00	0.00E+00	0.00E+00	1.05E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.08E-02
7.022	0.00E+00	0.00E+00	0.00E+00	9.16E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E-01
21.076	0.00E+00	0.00E+00	0.00E+00	1.15E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.03E-01
42.044	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.60E-01
71.241	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.55E-01
105.081	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.04E-01
147.088	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.15E+00
189.030	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.52E-01
231.006	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.84E-01
273.125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.14E-02
315.042	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.47E-02
357.008	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.30E-01
399.022	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.69E-02
469.032	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E-02

Bulkhead Insulation

Leaching Time (days)	PCB170	PCB180	PCB183	PCB184	PCB187	PCB189	Cl8	PCB195	Cl9	PCB206	Cl10	PCB209	tPCBs
0.007	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.170	0.00E+00	0.00E+00	0.00E+00	2.94E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.42E+00
7.076	0.00E+00	0.00E+00	0.00E+00	2.00E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.07E+01
14.083	0.00E+00	0.00E+00	0.00E+00	2.43E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.71E+01
21.097	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.67E+01
42.226	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.34E+01
69.301	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.99E+01
83.139	0.00E+00	0.00E+00	3.00E-02	2.56E-02	2.88E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.56E+01
118.135	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.84E+01
167.104	7.73E-02	8.35E-02	4.95E-02	0.00E+00	6.81E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E+02
209.131	0.00E+00	5.94E-02	0.00E+00	0.00E+00	5.63E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.51E+01
251.192	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.25E+01
286.150	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.84E+01
328.092	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.13E+01
370.117	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.92E+01
398.079	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.71E+01
454.319	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.40E+01

Table 18 Cont.

Rubber Products

Leaching Time (days)	PCB170	PCB180	PCB183	PCB184	PCB187	PCB189	Cl8	PCB195	Cl9	PCB206	Cl10	PCB209	tPCBs
0.006	0.00E+00	0.00E+00	0.00E+00	4.62E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.99E-04
1.169	0.00E+00	0.00E+00	0.00E+00	4.51E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.76E-04
7.074	0.00E+00	0.00E+00	0.00E+00	5.08E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.29E-03
14.081	0.00E+00	0.00E+00	0.00E+00	6.34E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.22E-03
28.153	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.76E-03
49.204	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.33E-03
69.272	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.52E-03
104.181	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-02
146.122	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.30E-02
188.072	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.61E-03
230.109	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.55E-03
286.142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.77E-03
328.083	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.20E-03
370.110	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.62E-03
398.072	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.93E-03
475.124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.01E-03

Cable Insulation

Leaching Time (days)	PCB170	PCB180	PCB183	PCB184	PCB187	PCB189	Cl8	PCB195	Cl9	PCB206	Cl10	PCB209	tPCBs
0.003	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.077	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6.009	0.00E+00	0.00E+00	0.00E+00	1.16E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E+00
20.035	0.00E+00	0.00E+00	0.00E+00	1.02E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.07E+00
40.989	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.99E+00
62.235	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.46E+00
90.010	0.00E+00	0.00E+00	0.00E+00	1.05E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E+00
125.028	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.00E-02	2.56E-02	2.24E-02	2.24E-02	2.45E+00
166.998	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.55E+00
208.968	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.05E+00
250.982	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.46E+00
300.024	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.03E-01
341.964	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.50E+00
383.993	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.16E+00
411.955	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.90E+00
474.981	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.28E+00

Vent. Gaskets

Leaching Time (days)	PCB170	PCB180	PCB183	PCB184	PCB187	PCB189	Cl8	PCB195	Cl9	PCB206	Cl10	PCB209	tPCBs
0.006	0.00E+00	0.00E+00	0.00E+00	7.42E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.80E-05
1.169	0.00E+00	0.00E+00	0.00E+00	7.24E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.43E-05
7.074	0.00E+00	0.00E+00	0.00E+00	8.14E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.89E-04
14.081	0.00E+00	0.00E+00	0.00E+00	1.02E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.98E-04
28.153	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E-03
49.204	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.18E-03
69.272	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.53E-03
104.181	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.92E-03
146.122	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.09E-03
188.072	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.38E-03
230.109	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.53E-03
286.142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.09E-03
328.083	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.34E-04
370.110	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.02E-04
398.072	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.52E-04
475.124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.45E-03

Table 19. Summary of the g PCB of total homolog released and fraction that was contributed by dioxin-like coplanar congeners. See Table 18 for raw data.

	Tetrachlorobiphenyl HOMOCL04		Pentachlorobiphenyl HOMOCL05		Hexachlorobiphenyl HOMOCL06		Heptachlorobiphenyl HOMOCL07	
	Total g PCB Released	Fraction Dioxin-like Congener	Total g PCB Released	Fraction Dioxin-like Congener	Total g PCB Released	Fraction Dioxin-like Congener	Total g PCB Released	Fraction Dioxin-like Congener
homolog	187.14722		372.12908		80.86429		3.71210	
PCB077	0.06293	0.00034						
PCB081a	0.00500	0.00003						
PCB105			10.39506	0.02793				
PCB114			0.36182	0.00097				
PCB118			23.66006	0.06358				
PCB123			0.00000	0.00000				
PCB126			0.00000	0.00000				
PCB156					0.62949	0.00778		
PCB157					0.02627	0.00032		
PCB167					0.09627	0.00119		
PCB169					0.00000	0.00000		
PCB170							0.07734	0.02083
PCB180							0.14294	0.03851
PCB189							0.00000	0.00000

a Congener was not measured, concentration of PCB081 was estimated assuming it was present in proportion to PCB077 using the proptionality observered in REEFEX fish

Table 20. Parameters from the literature used for calculating transfer from female to egg (A) and estimating concentrations of congeners (B) and the lip content of eggs (C).

A. Conversion factors from female to egg (roe) from literature.

	Female (Muscle)			Egg (Roe)			(EF) egg/female ratio			
	pg/g wet	f_lipid wet	pg/g lipid	pg/g wet	f_lipid wet	pg/g lipid	ratio	average	Source	Species
PCB077	3870.0	0.1690	22899.4	1340.0	0.0820	16341.5	0.714		Cook et al. 2003.	lake trout
PCB077	7.9	0.0613	129.5	15.1	0.1426	105.5	0.815		deBruyn et al. 2004	premigrating sockeye salmon
PCB077	14.1	0.0101	1391.1	38.7	0.1028	376.3	0.270		deBruyn et al. 2004	postmigrating sockeye salmon
								0.600		
PCB081	319.0	0.1690	1887.6	99.7	0.0820	1215.9	0.644		Cook et al. 2003.	lake trout
PCB081	0.7	0.0613	11.9	1.4	0.1426	10.0	0.836		deBruyn et al. 2004	premigrating sockeye salmon
PCB081	0.9	0.0101	89.1	2.8	0.1028	26.8	0.301		deBruyn et al. 2004	postmigrating sockeye salmon
								0.594		
PCB105	135000.0	0.1690	798816.6	43600.0	0.0820	531707.3	0.666		Cook et al. 2003.	lake trout
PCB105	162.9	0.0613	2657.4	336.2	0.1426	2357.4	0.887		deBruyn et al. 2004	premigrating sockeye salmon
PCB105	144.2	0.0101	14281.2	537.1	0.1028	5224.7	0.366		deBruyn et al. 2004	postmigrating sockeye salmon
								0.640		
PCB114	12.2	0.0613	198.2	26.2	0.1426	184.0	0.928		deBruyn et al. 2004	premigrating sockeye salmon
PCB114	11.0	0.0101	1093.1	40.9	0.1028	398.1	0.364		deBruyn et al. 2004	postmigrating sockeye salmon
								0.646		
PCB118	342000.0	0.1690	2023668.6	111000.0	0.0820	1353658.5	0.669		Cook et al. 2003.	lake trout
PCB118	409.9	0.0613	6687.3	818.3	0.1426	5738.4	0.858		deBruyn et al. 2004	premigrating sockeye salmon
PCB118	348.8	0.0101	34533.7	1282.4	0.1028	12475.0	0.361		deBruyn et al. 2004	postmigrating sockeye salmon
								0.629		
PCB123	13.6	0.0613	222.5	20.7	0.1426	145.0	0.652		deBruyn et al. 2004	premigrating sockeye salmon
PCB123	8.8	0.0101	875.2	30.6	0.1028	297.3	0.340		deBruyn et al. 2004	postmigrating sockeye salmon
								0.496		
PCB126	2470.0	0.1690	14615.4	731.0	0.0820	8914.6	0.610		Cook et al. 2003.	lake trout
PCB126	2.5	0.0613	40.5	4.1	0.1426	29.0	0.718		deBruyn et al. 2004	premigrating sockeye salmon
PCB126	2.0	0.0101	200.0	6.6	0.1028	63.8	0.319		deBruyn et al. 2004	postmigrating sockeye salmon
								0.549		
PCB156c	60500.0	0.1690	357988.2	16200.0	0.0820	197561.0	0.552		Cook et al. 2003.	lake trout
PCB156	28.5	0.0613	464.6	47.9	0.1426	335.9	0.723		deBruyn et al. 2004	premigrating sockeye salmon
PCB156	24.8	0.0101	2457.4	70.3	0.1028	684.2	0.278		deBruyn et al. 2004	postmigrating sockeye salmon
								0.518		
PCB157	7.9	0.0613	128.5	14.2	0.1426	99.6	0.775		deBruyn et al. 2004	premigrating sockeye salmon
PCB157	6.6	0.0101	657.4	19.8	0.1028	192.6	0.293		deBruyn et al. 2004	postmigrating sockeye salmon
								0.534		
PCB167	18.1	0.0613	295.4	31.6	0.1426	221.7	0.750		deBruyn et al. 2004	premigrating sockeye salmon
PCB167	17.0	0.0101	1687.1	43.2	0.1028	420.3	0.249		deBruyn et al. 2004	postmigrating sockeye salmon
								0.500		

	Female (Muscle)			Egg (Roe)			(EF) egg/female ratio			
	pg/g wet	f_lipid wet	pg/g lipid	pg/g wet	f_lipid wet	pg/g lipid	ratio	average	Source	Species
PCB169	143.0	0.1690	846.2	38.3	0.0820	467.1	0.552		Cook et al. 2003.	lake trout
PCB169	0.7	0.0613	11.4	0.6	0.1426	3.9	0.344		deBruyn et al. 2004	premigrating sockeye salmon
PCB169	0.5	0.0101	46.5	0.9	0.1028	8.9	0.192		deBruyn et al. 2004	postmigrating sockeye salmon
								0.363		
PCB189	1.5	0.0613	24.3	2.2	0.1426	15.4	0.632		deBruyn et al. 2004	premigrating sockeye salmon
PCB189	1.5	0.0101	151.5	2.2	0.1028	21.5	0.142		deBruyn et al. 2004	postmigrating sockeye salmon
								0.387		

B. Conversion factors for estimating tissue concentrations based on available data.

Ratio of	to	wet weight basis	Site	Species	congener average	Source	Comment
PCB081	PCB077	0.0824		Lake Trout		Cook et al. 2003.	lake trout
PCB081	PCB077	0.0919		Sockeye Salmon		deBruyn et al. 2004	premigrating sockeye salmon
PCB081	PCB077	0.0641		Sockeye Salmon		deBruyn et al. 2004	postmigrating sockeye salmon
					0.0795		
PCB156	PCB167	2.43	Reference	Black Sea Bass		Johnston et al. 2005	REEFEX fish
PCB156	PCB167	2.41	Target	Black Sea Bass		Johnston et al. 2005	REEFEX fish
PCB156	PCB167	2.22	Reference	Vermillion Snapper		Johnston et al. 2005	REEFEX fish
PCB156	PCB167	2.57	Target	Vermillion Snapper		Johnston et al. 2005	REEFEX fish
PCB156	PCB167	2.19	Reference	White Grunt		Johnston et al. 2005	REEFEX fish
PCB156	PCB167	2.78	Target	White Grunt		Johnston et al. 2005	REEFEX fish
PCB156	PCB167	2.50	all fish		2.5000	Johnston et al. 2005	REEFEX fish
PCB157	PCB167	0.69	Reference	Black Sea Bass		Johnston et al. 2005	REEFEX fish
PCB157	PCB167	0.62	Target	Black Sea Bass		Johnston et al. 2005	REEFEX fish
PCB157	PCB167	0.64	Reference	Vermillion Snapper		Johnston et al. 2005	REEFEX fish
PCB157	PCB167	0.61	Target	Vermillion Snapper		Johnston et al. 2005	REEFEX fish
PCB157	PCB167	0.68	Reference	White Grunt		Johnston et al. 2005	REEFEX fish
PCB157	PCB167	0.59	Target	White Grunt		Johnston et al. 2005	REEFEX fish
PCB157	PCB167	0.64	all fish		0.6400	Johnston et al. 2005	REEFEX fish
						Johnston et al. 2005	REEFEX fish

C. Average lipid content of eggs (roe) reported from literature.

%lipid content (wet weight)	mass fraction lipid/wet weight	f_eggLIPIDw Average	Source	Species
8.2	0.0820		Cook et al. 2003.	lake trout
14.26	0.1426		deBruyn et al. 2004	premigrating sockeye salmon
10.28	0.1028		deBruyn et al. 2004	postmigrating sockeye salmon
		0.1091		

Table 21. Summary of media, exposure pathways, benchmarks, endpoints, and stressors evaluated for the ecorisk analysis.

Media	Exposure Pathway	Benchmarks[a]	Endpoint/Receptor	Stressor
Water	Water		Primary Producer	Total PCB
			Primary Consumer	Total PCB
			Secondary Consumer	Total PCB
			Tertiary Consumer	Total PCB
Sediment	Sediment	Potential Sediment Effects TEL, PEL	Primary Producer	Total PCB
			Primary Consumer	Total PCB
			Secondary Consumer	Total PCB
Tissue Residue	Food Chain	Potential Bioaccumulation Effects TSV, Bcv	Primary Producer	Total PCB
			Primary Consumer	Total PCB
			Secondary Consumer	Total PCB
			Tertiary Consumer	Total PCB
Tissue Residue	Food Chain	Critical Body Residues NOED, LOED	Primary Consumer	Total PCB
			Secondary Consumer	Total PCB
			Tertiary Consumer	Total PCB, TEQ
Tissue Residue	Food Chain	Dietary Exposure NOAEL, LOAEL	Avian Omnivore (Herring Gull)	Total PCB, TEQ
			Avian Piscivore (Cormorant)	Total PCB, TEQ
			Secondary Consumer (Sea Turtle)	Total PCB
			Tertiary Consumer (Dolphin)	Total PCB, TEQ
			Tertiary Consumer (Shark)	Total PCB

a. Benchmarks listed are for conservative and less conservative, respectively.

Table 22. Summary of PCB concentrations (mg/Kg-ww) predicted by PRAM for ZOI=1, 2, 3, 4, 5, and 10.

ZOI=1

Tissue Conc. (mg/kg-WW)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca	Total PCB
Pelagic Community											
Phytoplankton (TL1)	1.676E-14	4.439E-10	3.571E-11	5.792E-10	7.606E-10	3.041E-11	1.246E-11	0.000E+00	5.612E-15	2.010E-17	1.862E-09
Zooplankton (TL-II)	6.050E-10	2.246E-05	2.266E-06	4.277E-05	4.242E-05	6.070E-06	5.400E-06	0.000E+00	2.708E-08	4.003E-09	1.214E-04
Planktivore (TL-III)	1.819E-10	2.531E-05	4.615E-06	1.688E-04	3.008E-04	4.733E-05	4.107E-05	0.000E+00	1.359E-07	7.152E-09	5.880E-04
Piscivore (TL-IV)	4.755E-11	4.461E-06	1.225E-06	9.859E-05	5.272E-04	1.420E-04	1.388E-04	0.000E+00	4.055E-07	8.845E-09	9.127E-04
Reef / Vessel Community											
Attached Algae	8.350E-11	2.248E-06	1.902E-07	3.161E-06	4.977E-06	4.841E-07	3.057E-07	0.000E+00	6.876E-10	3.074E-11	1.137E-05
Sessile filter feeder (TL-II)	1.468E-09	4.952E-05	4.891E-06	9.197E-05	8.903E-05	7.886E-06	5.710E-06	0.000E+00	1.828E-08	1.983E-09	2.490E-04
Invertebrate Omnivore (TL-II	1.523E-08	1.188E-03	1.758E-04	5.668E-03	9.186E-03	6.545E-04	3.455E-04	0.000E+00	2.527E-07	3.746E-09	1.722E-02
Invertebrate Forager (TL-III)	5.250E-08	2.152E-03	3.213E-04	1.087E-02	2.081E-02	1.654E-03	9.215E-04	0.000E+00	1.020E-06	6.540E-08	3.674E-02
Vertebrate Forager (TL-III)	1.421E-08	1.004E-03	2.165E-04	1.272E-02	4.530E-02	4.613E-03	2.709E-03	0.000E+00	3.057E-06	9.893E-08	6.657E-02
Predator (TL-IV)	7.885E-09	5.138E-04	1.217E-04	1.066E-02	8.247E-02	1.270E-02	8.181E-03	0.000E+00	8.810E-06	1.906E-07	1.147E-01
Benthic Community											
Infaunal invert. (TL-II)	3.954E-10	1.553E-05	1.614E-06	3.193E-05	3.205E-05	2.934E-06	2.144E-06	0.000E+00	5.984E-09	4.264E-10	8.621E-05
Epifaunal invert. (TL-II)	5.517E-10	3.249E-05	3.875E-06	8.770E-05	9.664E-05	9.264E-06	6.838E-06	0.000E+00	1.718E-08	9.420E-10	2.368E-04
Forager (TL-III)	7.142E-10	3.944E-05	6.031E-06	1.823E-04	2.716E-04	2.539E-05	1.730E-05	0.000E+00	2.758E-08	6.328E-10	5.421E-04
Predator (TL-IV)	1.457E-10	2.423E-05	6.388E-06	3.956E-04	1.192E-03	1.434E-04	1.013E-04	0.000E+00	1.302E-07	1.914E-09	1.863E-03

ZOI=2

Tissue Conc. (mg/kg-WW)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca	Total PCB
Pelagic Community											
Phytoplankton (TL1)	1.507E-14	3.991E-10	3.211E-11	5.207E-10	6.838E-10	2.735E-11	1.120E-11	0.000E+00	5.047E-15	1.807E-17	1.674E-09
Zooplankton (TL-II)	3.847E-10	1.429E-05	1.441E-06	2.720E-05	2.698E-05	3.860E-06	3.434E-06	0.000E+00	1.722E-08	2.545E-09	7.722E-05
Planktivore (TL-III)	1.157E-10	1.610E-05	2.935E-06	1.073E-04	1.913E-04	3.010E-05	2.611E-05	0.000E+00	8.639E-08	4.548E-09	3.740E-04
Piscivore (TL-IV)	3.024E-11	2.837E-06	7.791E-07	6.270E-05	3.353E-04	9.028E-05	8.828E-05	0.000E+00	2.579E-07	5.625E-09	5.804E-04
Reef / Vessel Community											
Attached Algae	5.309E-11	1.429E-06	1.209E-07	2.010E-06	3.165E-06	3.078E-07	1.944E-07	0.000E+00	4.372E-10	1.955E-11	7.228E-06
Sessile filter feeder (TL-II)	9.335E-10	3.149E-05	3.110E-06	5.848E-05	5.662E-05	5.014E-06	3.631E-06	0.000E+00	1.162E-08	1.261E-09	1.584E-04
Invertebrate Omnivore (TL-II	1.513E-08	1.176E-03	1.737E-04	5.591E-03	9.032E-03	6.389E-04	3.351E-04	0.000E+00	2.343E-07	3.166E-09	1.695E-02
Invertebrate Forager (TL-III)	5.231E-08	2.136E-03	3.184E-04	1.075E-02	2.052E-02	1.623E-03	9.003E-04	0.000E+00	9.901E-07	6.469E-08	3.624E-02
Vertebrate Forager (TL-III)	1.415E-08	9.949E-04	2.140E-04	1.254E-02	4.459E-02	4.516E-03	2.638E-03	0.000E+00	2.960E-06	9.732E-08	6.550E-02
Predator (TL-IV)	7.841E-09	5.098E-04	1.205E-04	1.052E-02	8.122E-02	1.244E-02	7.984E-03	0.000E+00	8.585E-06	1.886E-07	1.128E-01
Benthic Community											
Infaunal invert. (TL-II)	2.514E-10	9.875E-06	1.026E-06	2.030E-05	2.038E-05	1.866E-06	1.363E-06	0.000E+00	3.805E-09	2.711E-10	5.482E-05
Epifaunal invert. (TL-II)	3.508E-10	2.066E-05	2.464E-06	5.577E-05	6.146E-05	5.891E-06	4.348E-06	0.000E+00	1.092E-08	5.990E-10	1.506E-04
Forager (TL-III)	4.541E-10	2.508E-05	3.835E-06	1.159E-04	1.727E-04	1.615E-05	1.100E-05	0.000E+00	1.754E-08	4.024E-10	3.447E-04
Predator (TL-IV)	9.265E-11	1.541E-05	4.062E-06	2.516E-04	7.580E-04	9.120E-05	6.440E-05	0.000E+00	8.279E-08	1.217E-09	1.185E-03

Table 22. Cont.

ZOI=3

Tissue Conc. (mg/kg-WW)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca	Total PCB
Pelagic Community											
Phytoplankton (TL1)	1.442E-14	3.819E-10	3.073E-11	4.983E-10	6.545E-10	2.618E-11	1.072E-11	0.000E+00	4.831E-15	1.730E-17	1.602E-09
Zooplankton (TL-II)	3.007E-10	1.117E-05	1.127E-06	2.126E-05	2.109E-05	3.017E-06	2.684E-06	0.000E+00	1.346E-08	1.989E-09	6.036E-05
Planktivore (TL-III)	9.043E-11	1.258E-05	2.294E-06	8.391E-05	1.495E-04	2.353E-05	2.041E-05	0.000E+00	6.753E-08	3.555E-09	2.923E-04
Piscivore (TL-IV)	2.364E-11	2.218E-06	6.091E-07	4.901E-05	2.621E-04	7.057E-05	6.900E-05	0.000E+00	2.016E-07	4.396E-09	4.537E-04
Reef / Vessel Community											
Attached Algae	4.150E-11	1.117E-06	9.453E-08	1.571E-06	2.474E-06	2.406E-07	1.519E-07	0.000E+00	3.418E-10	1.528E-11	5.649E-06
Sessile filter feeder (TL-II)	7.297E-10	2.461E-05	2.431E-06	4.571E-05	4.425E-05	3.919E-06	2.838E-06	0.000E+00	9.084E-09	9.857E-10	1.238E-04
Invertebrate Omnivore (TL-II	1.509E-08	1.171E-03	1.729E-04	5.561E-03	8.973E-03	6.330E-04	3.312E-04	0.000E+00	2.273E-07	2.944E-09	1.684E-02
Invertebrate Forager (TL-III)	5.224E-08	2.131E-03	3.173E-04	1.070E-02	2.041E-02	1.611E-03	8.923E-04	0.000E+00	9.787E-07	6.442E-08	3.606E-02
Vertebrate Forager (TL-III)	1.413E-08	9.913E-04	2.130E-04	1.247E-02	4.432E-02	4.478E-03	2.612E-03	0.000E+00	2.923E-06	9.671E-08	6.509E-02
Predator (TL-IV)	7.825E-09	5.083E-04	1.201E-04	1.047E-02	8.075E-02	1.235E-02	7.909E-03	0.000E+00	8.499E-06	1.879E-07	1.121E-01
Benthic Community											
Infaunal invert. (TL-II)	1.965E-10	7.718E-06	8.022E-07	1.587E-05	1.593E-05	1.458E-06	1.066E-06	0.000E+00	2.974E-09	2.119E-10	4.285E-05
Epifaunal invert. (TL-II)	2.742E-10	1.615E-05	1.926E-06	4.359E-05	4.804E-05	4.604E-06	3.399E-06	0.000E+00	8.539E-09	4.682E-10	1.177E-04
Forager (TL-III)	3.550E-10	1.960E-05	2.998E-06	9.058E-05	1.350E-04	1.262E-05	8.600E-06	0.000E+00	1.371E-08	3.145E-10	2.694E-04
Predator (TL-IV)	7.241E-11	1.204E-05	3.175E-06	1.966E-04	5.925E-04	7.128E-05	5.034E-05	0.000E+00	6.471E-08	9.512E-10	9.260E-04

ZOI=4

Tissue Conc. (mg/kg-WW)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca	Total PCB
Pelagic Community											
Phytoplankton (TL1)	1.406E-14	3.724E-10	2.996E-11	4.859E-10	6.382E-10	2.552E-11	1.046E-11	0.000E+00	4.711E-15	1.687E-17	1.562E-09
Zooplankton (TL-II)	2.540E-10	9.431E-06	9.514E-07	1.796E-05	1.781E-05	2.548E-06	2.267E-06	0.000E+00	1.137E-08	1.680E-09	5.098E-05
Planktivore (TL-III)	7.638E-11	1.063E-05	1.938E-06	7.087E-05	1.263E-04	1.987E-05	1.724E-05	0.000E+00	5.703E-08	3.002E-09	2.469E-04
Piscivore (TL-IV)	1.997E-11	1.873E-06	5.144E-07	4.140E-05	2.214E-04	5.960E-05	5.827E-05	0.000E+00	1.702E-07	3.713E-09	3.832E-04
Reef / Vessel Community											
Attached Algae	3.504E-11	9.434E-07	7.983E-08	1.327E-06	2.089E-06	2.032E-07	1.283E-07	0.000E+00	2.886E-10	1.290E-11	4.771E-06
Sessile filter feeder (TL-II)	6.162E-10	2.078E-05	2.053E-06	3.860E-05	3.737E-05	3.310E-06	2.397E-06	0.000E+00	7.672E-09	8.324E-10	1.045E-04
Invertebrate Omnivore (TL-II	1.507E-08	1.168E-03	1.725E-04	5.545E-03	8.940E-03	6.297E-04	3.290E-04	0.000E+00	2.234E-07	2.821E-09	1.678E-02
Invertebrate Forager (TL-III)	5.220E-08	2.127E-03	3.167E-04	1.067E-02	2.034E-02	1.604E-03	8.878E-04	0.000E+00	9.723E-07	6.427E-08	3.595E-02
Vertebrate Forager (TL-III)	1.412E-08	9.894E-04	2.125E-04	1.243E-02	4.416E-02	4.458E-03	2.597E-03	0.000E+00	2.902E-06	9.637E-08	6.486E-02
Predator (TL-IV)	7.815E-09	5.075E-04	1.198E-04	1.044E-02	8.048E-02	1.229E-02	7.868E-03	0.000E+00	8.451E-06	1.875E-07	1.117E-01
Benthic Community											
Infaunal invert. (TL-II)	1.659E-10	6.518E-06	6.774E-07	1.340E-05	1.345E-05	1.231E-06	8.999E-07	0.000E+00	2.512E-09	1.790E-10	3.619E-05
Epifaunal invert. (TL-II)	2.316E-10	1.364E-05	1.626E-06	3.681E-05	4.057E-05	3.888E-06	2.870E-06	0.000E+00	7.211E-09	3.954E-10	9.941E-05
Forager (TL-III)	2.998E-10	1.656E-05	2.531E-06	7.650E-05	1.140E-04	1.066E-05	7.263E-06	0.000E+00	1.158E-08	2.656E-10	2.275E-04
Predator (TL-IV)	6.115E-11	1.017E-05	2.681E-06	1.661E-04	5.004E-04	6.020E-05	4.251E-05	0.000E+00	5.465E-08	8.033E-10	7.821E-04

ZOI=5

Tissue Conc. (mg/kg-WW)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca	Total PCB
Pelagic Community											
Phytoplankton (TL1)	1.382E-14	3.661E-10	2.946E-11	4.777E-10	6.275E-10	2.510E-11	1.028E-11	0.000E+00	4.633E-15	1.659E-17	1.536E-09
Zooplankton (TL-II)	2.234E-10	8.295E-06	8.368E-07	1.579E-05	1.567E-05	2.241E-06	1.994E-06	0.000E+00	9.996E-09	1.478E-09	4.484E-05
Planktivore (TL-III)	6.719E-11	9.348E-06	1.704E-06	6.233E-05	1.111E-04	1.748E-05	1.516E-05	0.000E+00	5.016E-08	2.640E-09	2.172E-04
Piscivore (TL-IV)	1.757E-11	1.648E-06	4.525E-07	3.641E-05	1.947E-04	5.242E-05	5.125E-05	0.000E+00	1.497E-07	3.265E-09	3.371E-04
Reef / Vessel Community											
Attached Algae	3.082E-11	8.297E-07	7.021E-08	1.167E-06	1.837E-06	1.787E-07	1.128E-07	0.000E+00	2.538E-10	1.135E-11	4.196E-06
Sessile filter feeder (TL-II)	5.420E-10	1.828E-05	1.806E-06	3.395E-05	3.287E-05	2.911E-06	2.108E-06	0.000E+00	6.748E-09	7.322E-10	9.194E-05
Invertebrate Omnivore (TL-II	1.505E-08	1.167E-03	1.722E-04	5.534E-03	8.918E-03	6.275E-04	3.276E-04	0.000E+00	2.209E-07	2.740E-09	1.675E-02
Invertebrate Forager (TL-III)	5.217E-08	2.125E-03	3.163E-04	1.065E-02	2.030E-02	1.600E-03	8.848E-04	0.000E+00	9.682E-07	6.418E-08	3.588E-02
Vertebrate Forager (TL-III)	1.411E-08	9.880E-04	2.121E-04	1.241E-02	4.406E-02	4.444E-03	2.587E-03	0.000E+00	2.889E-06	9.615E-08	6.471E-02
Predator (TL-IV)	7.809E-09	5.069E-04	1.196E-04	1.042E-02	8.031E-02	1.226E-02	7.840E-03	0.000E+00	8.420E-06	1.872E-07	1.115E-01
Benthic Community											
Infaunal invert. (TL-II)	1.460E-10	5.733E-06	5.958E-07	1.179E-05	1.183E-05	1.083E-06	7.915E-07	0.000E+00	2.209E-09	1.574E-10	3.183E-05
Epifaunal invert. (TL-II)	2.037E-10	1.199E-05	1.431E-06	3.238E-05	3.568E-05	3.420E-06	2.525E-06	0.000E+00	6.343E-09	3.478E-10	8.744E-05
Forager (TL-III)	2.636E-10	1.456E-05	2.226E-06	6.728E-05	1.003E-04	9.375E-06	6.388E-06	0.000E+00	1.018E-08	2.336E-10	2.001E-04
Predator (TL-IV)	5.379E-11	8.946E-06	2.358E-06	1.461E-04	4.401E-04	5.295E-05	3.739E-05	0.000E+00	4.806E-08	7.065E-10	6.879E-04

ZOI=10

Tissue Conc. (mg/kg-WW)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca	Total PCB
Pelagic Community											
Phytoplankton (TL1)	1.326E-14	3.513E-10	2.827E-11	4.585E-10	6.023E-10	2.410E-11	9.872E-12	0.000E+00	4.449E-15	1.593E-17	1.474E-09
Zooplankton (TL-II)	1.517E-10	5.634E-06	5.684E-07	1.073E-05	1.064E-05	1.522E-06	1.354E-06	0.000E+00	6.788E-09	1.003E-09	3.045E-05
Planktivore (TL-III)	4.564E-11	6.349E-06	1.158E-06	4.234E-05	7.545E-05	1.187E-05	1.030E-05	0.000E+00	3.406E-08	1.793E-09	1.475E-04
Piscivore (TL-IV)	1.194E-11	1.119E-06	3.074E-07	2.473E-05	1.323E-04	3.560E-05	3.480E-05	0.000E+00	1.017E-07	2.217E-09	2.289E-04
Reef / Vessel Community											
Attached Algae	2.093E-11	5.634E-07	4.767E-08	7.923E-07	1.248E-06	1.213E-07	7.662E-08	0.000E+00	1.724E-10	7.707E-12	2.849E-06
Sessile filter feeder (TL-II)	3.680E-10	1.241E-05	1.226E-06	2.306E-05	2.232E-05	1.977E-06	1.431E-06	0.000E+00	4.582E-09	4.971E-10	6.243E-05
Invertebrate Omnivore (TL-II	1.502E-08	1.163E-03	1.715E-04	5.509E-03	8.868E-03	6.224E-04	3.242E-04	0.000E+00	2.149E-07	2.551E-09	1.666E-02
Invertebrate Forager (TL-III)	5.211E-08	2.120E-03	3.153E-04	1.061E-02	2.021E-02	1.589E-03	8.779E-04	0.000E+00	9.585E-07	6.394E-08	3.572E-02
Vertebrate Forager (TL-III)	1.409E-08	9.850E-04	2.113E-04	1.235E-02	4.383E-02	4.412E-03	2.564E-03	0.000E+00	2.857E-06	9.563E-08	6.436E-02
Predator (TL-IV)	7.795E-09	5.056E-04	1.192E-04	1.037E-02	7.990E-02	1.218E-02	7.776E-03	0.000E+00	8.347E-06	1.865E-07	1.109E-01
Benthic Community											
Infaunal invert. (TL-II)	9.910E-11	3.893E-06	4.046E-07	8.004E-06	8.036E-06	7.355E-07	5.375E-07	0.000E+00	1.500E-09	1.069E-10	2.161E-05
Epifaunal invert. (TL-II)	1.383E-10	8.144E-06	9.714E-07	2.199E-05	2.423E-05	2.322E-06	1.714E-06	0.000E+00	4.307E-09	2.361E-10	5.938E-05
Forager (TL-III)	1.790E-10	9.887E-06	1.512E-06	4.569E-05	6.809E-05	6.366E-06	4.337E-06	0.000E+00	6.915E-09	1.586E-10	1.359E-04
Predator (TL-IV)	3.652E-11	6.074E-06	1.601E-06	9.918E-05	2.989E-04	3.595E-05	2.539E-05	0.000E+00	3.264E-08	4.798E-10	4.671E-04

Table 23. Summary of BAFs (L/Kg-lipid) calculated by PRAM for ZOI=1, 2, 5, and 10.

ZOI=1

BAFs (L/kg-lipid)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Pelagic Community										
Phytoplankton (TL1)	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Zooplankton (TL-II)	1.347E+05	6.237E+05	7.436E+05	8.445E+05	5.319E+05	7.826E+05	1.103E+06	0.000E+00	2.458E+06	8.127E+06
Planktivore (TL-III)	7.604E+04	1.320E+06	2.844E+06	**6.259E+06**	7.084E+06	1.147E+07	1.576E+07	0.000E+00	2.317E+07	2.729E+07
Piscivore (TL-IV)	1.988E+04	2.326E+05	7.549E+05	3.656E+06	**1.242E+07**	**3.439E+07**	**5.326E+07**	0.000E+00	**6.917E+07**	**3.375E+07**
Reef / Vessel Community										
Attached Algae	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Sessile filter feeder (TL-II)	**9.590E+05**	**4.034E+06**	4.709E+06	5.328E+06	3.275E+06	2.983E+06	3.420E+06	0.000E+00	4.867E+06	1.181E+07
Invertebrate Omnivore (TL-II	3.231E+04	3.143E+05	**5.495E+05**	1.066E+06	1.097E+06	8.039E+05	6.721E+05	0.000E+00	2.185E+05	7.246E+04
Invertebrate Forager (TL-III)	1.634E+05	8.353E+05	1.474E+06	3.001E+06	3.648E+06	2.981E+06	2.630E+06	0.000E+00	1.294E+06	1.856E+06
Vertebrate Forager (TL-III)	1.502E+04	1.324E+05	3.373E+05	1.193E+06	2.698E+06	2.825E+06	2.627E+06	0.000E+00	1.318E+06	9.538E+05
Predator (TL-IV)	1.243E+04	1.010E+05	2.827E+05	1.490E+06	7.321E+06	1.159E+07	1.183E+07	0.000E+00	5.661E+06	2.739E+06
Benthic Community										
Infaunal invert. (TL-II)	2.429E+05	1.190E+06	1.462E+06	1.740E+06	1.109E+06	1.044E+06	1.208E+06	0.000E+00	1.499E+06	2.389E+06
Epifaunal invert. (TL-II)	3.013E+05	2.213E+06	3.119E+06	4.248E+06	2.973E+06	2.930E+06	3.425E+06	0.000E+00	3.825E+06	4.691E+06
Forager (TL-III)	1.759E+05	1.212E+06	2.189E+06	3.981E+06	3.768E+06	3.622E+06	3.908E+06	0.000E+00	2.770E+06	1.421E+06
Predator (TL-IV)	1.557E+04	3.231E+05	1.006E+06	3.750E+06	7.176E+06	8.877E+06	9.928E+06	0.000E+00	5.673E+06	1.865E+06
	9.590E+05	4.034E+06	4.709E+06	6.259E+06	1.242E+07	3.439E+07	5.326E+07	0.000E+00	6.917E+07	3.375E+07

ZOI=2

BAFs (L/kg-lipid)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Pelagic Community										
Phytoplankton (TL1)	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Zooplankton (TL-II)	1.347E+05	6.238E+05	7.436E+05	8.445E+05	5.320E+05	7.826E+05	1.103E+06	0.000E+00	2.458E+06	8.127E+06
Planktivore (TL-III)	7.603E+04	1.320E+06	2.843E+06	6.258E+06	7.083E+06	1.146E+07	1.576E+07	0.000E+00	2.317E+07	2.729E+07
Piscivore (TL-IV)	1.988E+04	2.326E+05	7.548E+05	3.655E+06	1.242E+07	3.439E+07	5.326E+07	0.000E+00	6.917E+07	3.375E+07
Reef / Vessel Community										
Attached Algae	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Sessile filter feeder (TL-II)	9.590E+05	4.034E+06	4.709E+06	5.328E+06	3.276E+06	2.983E+06	3.420E+06	0.000E+00	4.867E+06	1.181E+07
Invertebrate Omnivore (TL-II	3.226E+04	3.127E+05	5.460E+05	1.057E+06	1.085E+06	7.891E+05	6.556E+05	0.000E+00	2.037E+05	6.157E+04
Invertebrate Forager (TL-III)	1.633E+05	8.319E+05	1.465E+06	2.976E+06	3.608E+06	2.934E+06	2.578E+06	0.000E+00	1.260E+06	1.842E+06
Vertebrate Forager (TL-III)	1.501E+04	1.316E+05	3.345E+05	1.180E+06	2.664E+06	2.774E+06	2.567E+06	0.000E+00	1.280E+06	9.414E+05
Predator (TL-IV)	1.243E+04	1.008E+05	2.815E+05	1.479E+06	7.250E+06	1.142E+07	1.161E+07	0.000E+00	5.547E+06	2.726E+06
Benthic Community										
Infaunal invert. (TL-II)	2.429E+05	1.190E+06	1.462E+06	1.740E+06	1.109E+06	1.044E+06	1.208E+06	0.000E+00	1.499E+06	2.389E+06
Epifaunal invert. (TL-II)	3.013E+05	2.213E+06	3.119E+06	4.248E+06	2.973E+06	2.930E+06	3.425E+06	0.000E+00	3.825E+06	4.691E+06
Forager (TL-III)	1.759E+05	1.212E+06	2.189E+06	3.981E+06	3.768E+06	3.622E+06	3.909E+06	0.000E+00	2.770E+06	1.421E+06
Predator (TL-IV)	1.557E+04	3.231E+05	1.006E+06	3.750E+06	7.177E+06	8.877E+06	9.928E+06	0.000E+00	5.673E+06	1.865E+06

Table 23 Cont.

ZOI=5

BAFs (L/kg-lipid)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Pelagic Community										
Phytoplankton (TL1)	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Zooplankton (TL-II)	1.347E+05	6.238E+05	7.437E+05	8.446E+05	5.321E+05	7.827E+05	1.103E+06	0.000E+00	2.458E+06	8.127E+06
Planktivore (TL-III)	7.602E+04	1.319E+06	2.842E+06	6.256E+06	7.082E+06	1.146E+07	1.575E+07	0.000E+00	2.317E+07	2.729E+07
Piscivore (TL-IV)	1.988E+04	2.325E+05	7.546E+05	3.654E+06	1.241E+07	3.439E+07	5.326E+07	0.000E+00	6.917E+07	3.375E+07
Reef / Vessel Community										
Attached Algae	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Sessile filter feeder (TL-II)	9.590E+05	4.034E+06	4.709E+06	5.328E+06	3.276E+06	2.983E+06	3.420E+06	0.000E+00	4.867E+06	1.181E+07
Invertebrate Omnivore (TL-II	3.223E+04	3.116E+05	5.434E+05	1.051E+06	1.076E+06	7.781E+05	6.433E+05	0.000E+00	1.928E+05	5.351E+04
Invertebrate Forager (TL-III)	1.633E+05	8.295E+05	1.459E+06	2.957E+06	3.579E+06	2.899E+06	2.540E+06	0.000E+00	1.235E+06	1.831E+06
Vertebrate Forager (TL-III)	1.500E+04	1.310E+05	3.324E+05	1.170E+06	2.639E+06	2.736E+06	2.523E+06	0.000E+00	1.252E+06	9.322E+05
Predator (TL-IV)	1.243E+04	1.006E+05	2.806E+05	1.470E+06	7.197E+06	1.130E+07	1.144E+07	0.000E+00	5.462E+06	2.716E+06
Benthic Community										
Infaunal invert. (TL-II)	2.429E+05	1.190E+06	1.462E+06	1.740E+06	1.109E+06	1.044E+06	1.208E+06	0.000E+00	1.499E+06	2.389E+06
Epifaunal invert. (TL-II)	3.013E+05	2.213E+06	3.119E+06	4.248E+06	2.973E+06	2.930E+06	3.425E+06	0.000E+00	3.825E+06	4.691E+06
Forager (TL-III)	1.759E+05	1.212E+06	2.189E+06	3.981E+06	3.768E+06	3.622E+06	3.909E+06	0.000E+00	2.770E+06	1.421E+06
Predator (TL-IV)	1.557E+04	3.231E+05	1.006E+06	3.751E+06	7.177E+06	8.878E+06	9.928E+06	0.000E+00	5.673E+06	1.865E+06

ZOI=10

BAFs (L/kg-lipid)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Pelagic Community										
Phytoplankton (TL1)	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Zooplankton (TL-II)	1.347E+05	6.239E+05	7.438E+05	8.447E+05	5.321E+05	7.827E+05	1.103E+06	0.000E+00	2.458E+06	8.127E+06
Planktivore (TL-III)	7.601E+04	1.319E+06	2.841E+06	**6.254E+06**	7.080E+06	1.146E+07	1.575E+07	0.000E+00	2.317E+07	2.729E+07
Piscivore (TL-IV)	1.988E+04	2.325E+05	7.544E+05	3.653E+06	**1.241E+07**	**3.438E+07**	**5.325E+07**	0.000E+00	**6.917E+07**	**3.375E+07**
Reef / Vessel Community										
Attached Algae	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Sessile filter feeder (TL-II)	**9.590E+05**	**4.035E+06**	**4.709E+06**	5.329E+06	3.276E+06	2.983E+06	3.421E+06	0.000E+00	4.867E+06	1.181E+07
Invertebrate Omnivore (TL-II	3.221E+04	3.111E+05	5.422E+05	1.048E+06	1.071E+06	7.733E+05	6.379E+05	0.000E+00	1.879E+05	4.991E+04
Invertebrate Forager (TL-III)	1.632E+05	8.284E+05	1.456E+06	2.949E+06	3.565E+06	2.883E+06	2.523E+06	0.000E+00	1.224E+06	1.827E+06
Vertebrate Forager (TL-III)	1.500E+04	1.308E+05	3.315E+05	1.166E+06	2.628E+06	2.720E+06	2.503E+06	0.000E+00	1.240E+06	9.282E+05
Predator (TL-IV)	1.243E+04	1.005E+05	2.801E+05	1.466E+06	7.174E+06	1.124E+07	1.137E+07	0.000E+00	5.425E+06	2.712E+06
Benthic Community										
Infaunal invert. (TL-II)	2.429E+05	1.190E+06	1.462E+06	1.740E+06	1.109E+06	1.044E+06	1.208E+06	0.000E+00	1.499E+06	2.389E+06
Epifaunal invert. (TL-II)	3.013E+05	2.213E+06	3.120E+06	4.249E+06	2.974E+06	2.930E+06	3.426E+06	0.000E+00	3.825E+06	4.691E+06
Forager (TL-III)	1.759E+05	1.212E+06	2.190E+06	3.982E+06	3.768E+06	3.622E+06	3.909E+06	0.000E+00	2.770E+06	1.421E+06
Predator (TL-IV)	1.557E+04	3.231E+05	1.006E+06	3.751E+06	7.178E+06	8.878E+06	9.929E+06	0.000E+00	5.673E+06	1.865E+06
	9.590E+05	4.035E+06	4.709E+06	6.254E+06	1.241E+07	3.438E+07	5.325E+07	0.000E+00	6.917E+07	3.375E+07

Table 24. The default dietary preferences used by PRAM and the Trophic Level determined by diet for each compartment modeled in the food chain.

PRAM Default Dietary Preferences	Suspended Solids (Upper Water Column)	Suspended Solids (Lower Water Column)	Sediment	Phyto plankton	Zoo plankton	Pelagic Plankitivore	Attached Algae	Reef Sessile Filter Feeder	Invertebrate Omnivore	Reef Invertebrate Forager	Reef Vertebrate Forager	Infaunal Benthos	Epifaunal Benthos	Benthic Forager	TROPHIC LEVEL
Trophic Level	1.125	1.250	1.500	1.000	2.056	3.056	1.000	2.131	2.226	3.177	2.965	2.461	2.702	3.521	
Pelagic Community															
Phytoplankton (TL1)															1.0000
Zooplankton (TL-II)	15%	15%		70%											2.0563
Planktivore (TL-III)					100%										3.0563
Piscivore (TL-IV)					10%	90%									3.9563
Reef / Vessel Community															
Attached Algae															1.0000
Sessile filter feeder (TL-II)		10%		80%	10%										2.1306
Invertebrate Omnivore (TL-I							80%	20%							2.2261
Invertebrate Forager (TL-III)		5%			5%	5%		35%	50%						3.1769
Vertebrate Forager (TL-III)						19%		19%	15%	22%		12.5%	12.5%		2.9648
Predator (TL-IV)										15%	60%	8%	8%	8%	3.9501
Benthic Community															
Infaunal invert. (TL-II)			50%	30%	20%										2.4613
Epifaunal invert. (TL-II)			25%	30%	20%							25%			2.7016
Forager (TL-III)			5%									50%	45%		3.5213
Predator (TL-IV)			2%									20%	20%	58%	4.1049

Table 25. Calculation of PCB biomagnification factors (BMF_{TLC}) for trophic levels (TL) 3:2, 4:3, and 4:2 observed in pelagic, demersal, and benthic food webs from Grand Traverse Bay, Lake Michigan (Stapleton et al. 2001), False Creek Harbor, Vancouver, BC Canada (Mackintosh et al. 2004), a demersal food web from the Northwater Polynya, Arctic (Fisk, Hobson, & Norstrom 2001), and predicted by PRAM.

		average			average - std			average + std		
Data from Stapleton et al. 2001		sumPCB	BMF_{TLC}			BMF_{TLC}			BMF_{TLC}	
Lake Pelagic	TL	ng/g lipid	3:2 / 4:3	4:2	sumPCB n	3:2 / 4:3	4:2	sumPCB n	3:2 / 4:3	4:2
Zooplankton	2.00	1120.0			351.0			2914.3		
Alewife	3.00	4957.4	3.0		2144.7	4.1		16833.3	3.9	
Lake Trout	4.00	8522.7	1.3	3.8	4048.1	1.4	5.8	16801.6	0.7	2.9
Lake Demersal										
Mysid	2.00	828.6			378.9			1777.8		
Bloater	3.00	13135.6	10.6		6740.5	11.9		26089.7	9.8	
Burbot	4.00	17750.0	1.0	10.7	17750.0	2.0	23.4	17750.0	0.5	5.0
Lake Benthic										
Amphipod	2.00	1447.1			670.8			3310.0		
Sculpin	3.00	3468.2	1.6		1479.8	1.5		7073.2	1.4	
Salmon	4.00	23788.5	5.1	8.2	23788.5	12.1	17.7	23788.5	2.5	3.6
Data from Mackintosh et al. 2004										
		PCB118	BMF_{TLC}			BMF_{TLC}			BMF_{TLC}	
Coastal Pelagic	TL	ng/g lipid	3:2 / 4:3	4:2	PCB118 n(	3:2 / 4:3	4:2	PCB118 n(	3:2 / 4:3	4:2
Juvenile Perch	2.30	263.0			166.0			416.9		
Greenling	3.81	354.8	0.8		95.5	0.3		1318.3	1.9	
Dogfish	4.07	645.7	1.7	1.4	302.0	3.0	1.0	1380.4	1.0	1.9
Coastal Demersal										
Oyster	2.48	64.6			37.2			112.2		
Crab	3.55	467.7	5.1		245.5	4.6		891.3	5.5	
Dogfish	4.07	645.7	1.2	6.1	302.0	1.1	5.0	1380.4	1.4	7.5
Coastal Benthic										
Manila Clam/Geoduck Clam	2.40	34.5			3.0			134.9		
English Sole	3.64	549.5	10.5		112.2	25.1		2691.5	13.2	
Dogfish	4.07	645.7	1.1	11.0	302.0	2.4	60.3	1380.4	0.5	6.0
Reported by Fisk, Hobson, & Norstrom 2001										
			BMF_{TLC}							
Arctic Benthic	TL	sumPCB	3:2 / 4:3	4:2						
Copepod	2.0									
Amphipod	2.6		7.8							
Artic Cod	3.7		0.9							

Table 25. Cont.

Data from PRAM 1.4C

Tissue Conc. (mg/kg-lipid)		mg/Kg Lipid	BMF_{TLC}	
Pelagic Community	TL	Total PCB	3:2 / 4:3	4:2
Phytoplankton (TL1)	1.00	1.02E-07		
Zooplankton (TL-II)	2.06	0.001462		
Planktivore (TL-III)	3.06	0.005323	2.4	
Piscivore (TL-IV)	3.96	0.008262	1.2	2.9
Reef / Vessel Community				
Attached Algae	1.00	0.000439		
Sessile filter feeder (TL-II)	2.13	0.017595		
Invertebrate Omnivore (TL-II)	2.23	0.324634		
Invertebrate Forager (TL-III)	3.18	1.518546	3.3	
Vertebrate Forager (TL-III)	2.96	0.932337	2.2	
Predator (TL-IV)	3.95	1.605862	1.3	2.79
Benthic Community				
Infaunal invert. (TL-II)	2.46	0.005729		
Epifaunal invert. (TL-II)	2.70	0.013991		
Forager (TL-III)	3.52	0.014441	1.8	
Predator (TL-IV)	4.10	0.021541	1.3	2.3

Table 26. The food web magnification factor (FWMF) calculated from the regression of ln(PCB) versus TL to obtain the slope (b) for the accumulation of each homolog in the pelagic, reef, and benthic communities modeled by PRAM.

Food Chain	chemical	log(Kow)	b	r^2	FWMF
PELAGIC	Mono	4.474	-1.488	1.00	0.23
PELAGIC	Di	5.236	-0.9857	0.79	0.37
PELAGIC	Tri	5.521	-0.4574	0.41	0.63
PELAGIC	Tetra	5.922	0.304	0.28	1.36
PELAGIC	Penta	6.4951	1.1852	0.94	3.27
PELAGIC	Hexa	6.9761	1.5136	0.99	4.54
PELAGIC	Hepta	7.19	1.5619	0.99	4.77
PELAGIC	Nona	8.351	1.2752	0.99	3.58
PELAGIC	Deca	9.603	0.2675	0.99	1.31
REEF	Mono	4.474	0.1444	0.00	1.16
REEF	Di	5.236	0.2575	0.03	1.29
REEF	Tri	5.521	0.6319	0.13	1.88
REEF	Tetra	5.922	1.316	0.38	3.73
REEF	Penta	6.4951	2.285	0.63	9.83
REEF	Hexa	6.9761	2.6	0.73	13.46
REEF	Hepta	7.19	2.597	0.77	13.42
REEF	Nona	8.351	2.3579	0.89	10.57
REEF	Deca	9.603	2.1129	0.79	8.27
BENTHIC	Mono	4.474	-1.576	0.75	0.21
BENTHIC	Di	5.236	-0.865	0.65	0.42
BENTHIC	Tri	5.521	-0.34	0.28	0.71
BENTHIC	Tetra	5.922	0.3047	0.30	1.36
BENTHIC	Penta	6.4951	0.9336	0.83	2.54
BENTHIC	Hexa	6.9761	1.0687	0.85	2.91
BENTHIC	Hepta	7.19	1.0346	0.82	2.81
BENTHIC	Nona	8.351	0.5492	0.55	1.73
BENTHIC	Deca	9.603	-0.4238	0.39	0.65

Table 27. Summary of overall risk to the assessment endpoints based on the hazard quotients (HQ) of exceeding effects levels for Total PCB and TEQ obtained from short-term (0 - 2 yr) and long-term (steady state) predictions obtained from the TDM and PRAM models for the reef community 15m from the reef (ZOI=1).

Endpoint	**Risk of exceeding benchmark** **Benchmark**		**Overall Risk to Endpoint**
Potentailly Harmfull PCB Water Exposure to Ecological Receptors at the Reef	FLWQCaa	FLWQCmax	Negligible
	Negligible	Negligible	
Potentially Harmful PCB Sediment Exposure to Ecological Receptors at the Reef	TEL	PEL	Negligible
	Negligible	Negligible	
Potentially Harmful PCB Exposure to Primary Producers and Consumers of the Reef Community	TSV	Bcv	Negligible
	Very Low	Negligible	
Critical Body Residues of PCBs in Demersal Fish	NOED	LOED	Negligible
	Negligible	Negligible	
Harmful PCB Exposure to Dolphins from Consumption of Prey	NOAEL	LOAEL	Negligible
	Very Low	Negligible	
Harmful PCB Exposure to Gulls from Consumption of Prey	NOAEL	LOAEL	Negligible
	Very Low	Negligible	
Harmful PCB Exposure to Cormorants from Consumption of Prey	NOAEL	LOAEL	Negligible
	Very Low	Negligible	
Harmful PCB Exposure to Sea Turtles from Consumption of Prey	NOAEL	LOAEL	Negligible
	Negligible	Negligible	
Harmful PCB Exposure to Sharks from Consumption of Prey	NOAEL	LOAEL	Negligible
	Negligible	Negligible	
Harmful TEQ Exposure to Fish Eggs	NOAEL	LOAEL	Negligible
	Negligible	Negligible	
Harmful TEQ Exposure to Dolphins from Consumption of Prey	NOAEL	LOAEL	Negligible
	Negligible	Negligible	
Harmful TEQ Exposure to Gulls from Consumption of Prey	NOAEL	LOAEL	Negligible
	Negligible	Negligible	
Harmful TEQ Exposure to Cormorants from Consumption of Prey	NOAEL	LOAEL	Negligible
	Negligible	Negligible	

11. Figures

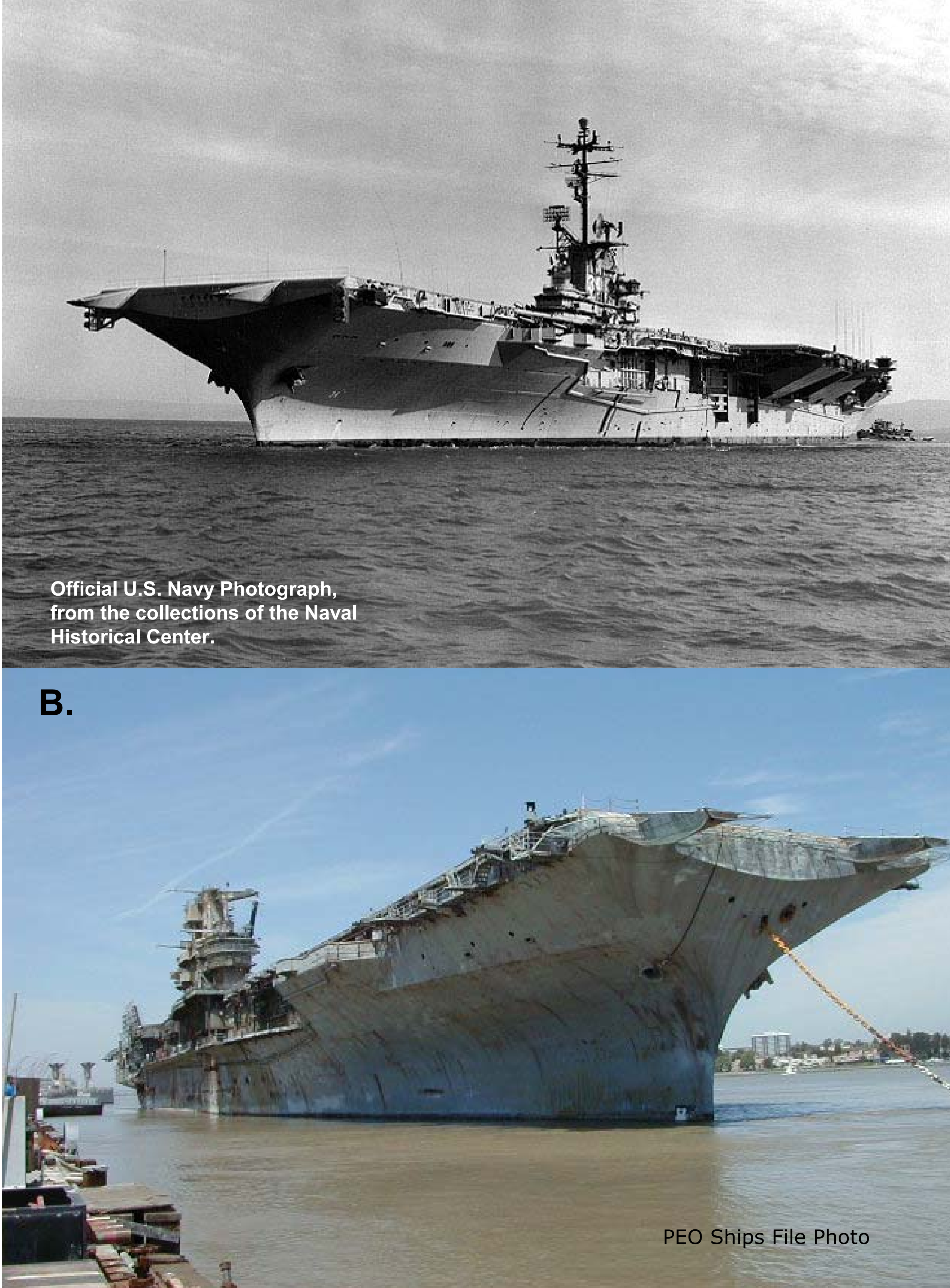


Figure 1. The aircraft carrier ORISKANY as she left San Francisco Naval Shipyard, CA, on 27 April 1959, following installation of her new angled flight deck and hurricane bow (A) and pier side at Port of Pensacola March 2005 undergoing preparations for possible beneficial reuse as an artificial reef (B).

Figure 2. The proposed location for sinking the ex-ORISKANY to create an artificial reef off the coast of Pensacola, FL (from FFWCC 2003).

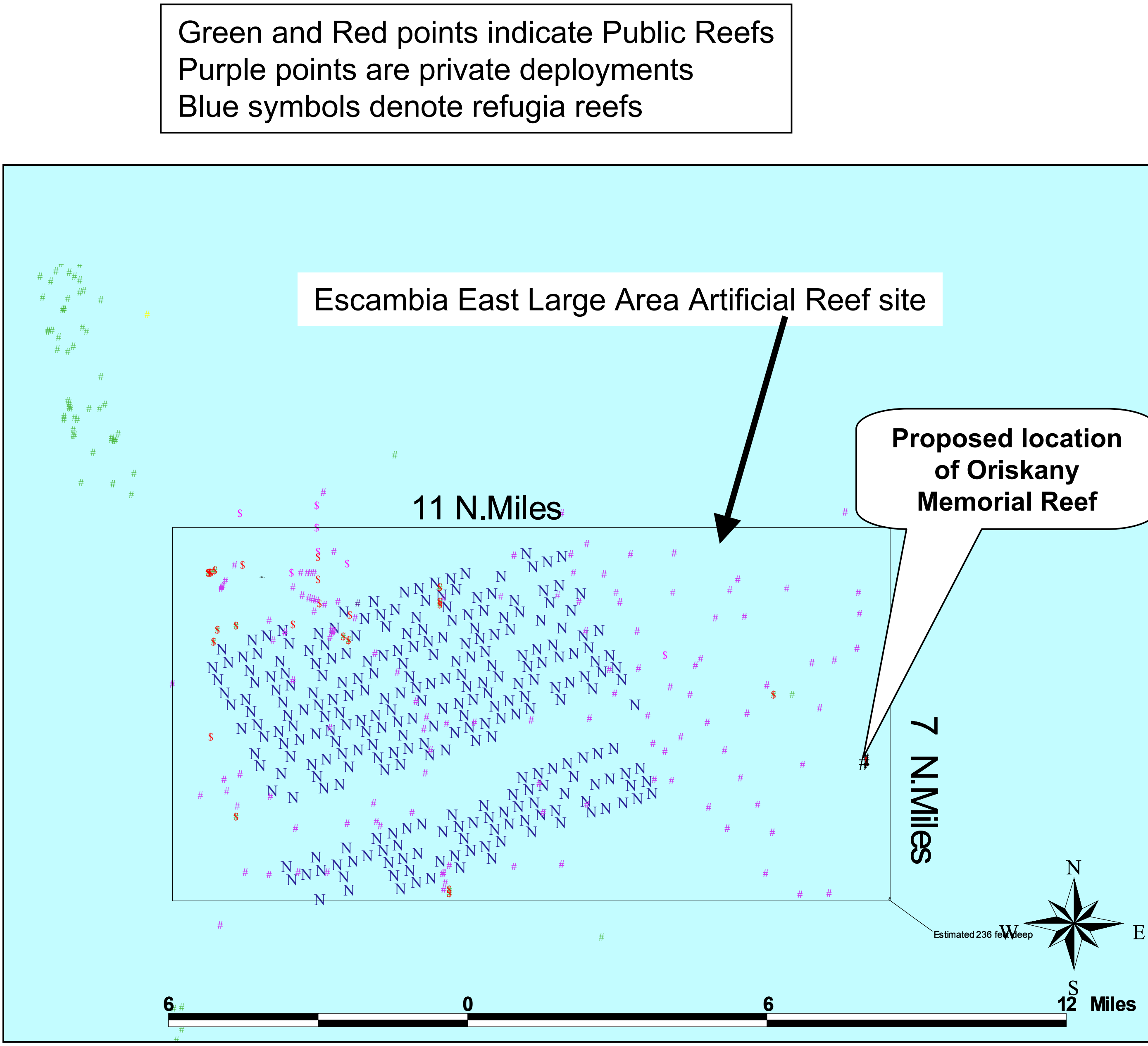


Figure 3. The proposed location of ex-ORISKANY artificial reef within the Escambia East Large Area Artificial Reef site and the location of existing public, private, and refugia reefs within the area (from FFWCC 2004).

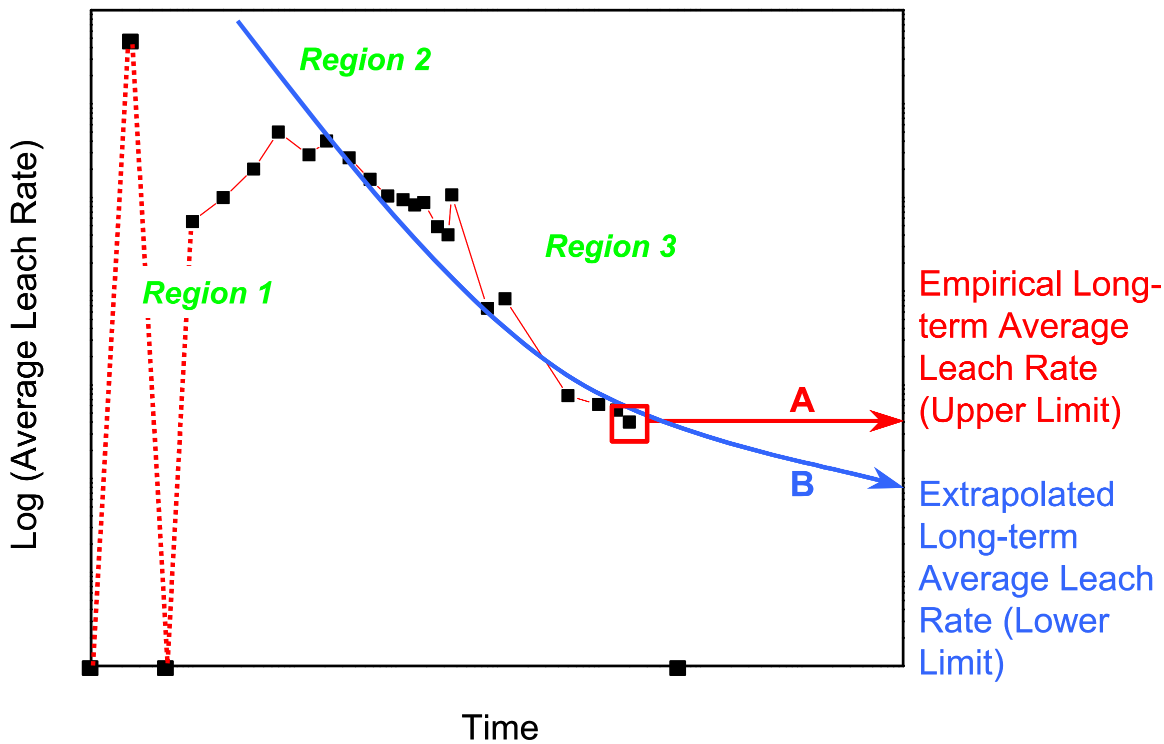


Figure 4. The conceptualized leaching behavior of PCBs from ship-board solids tested under laboratory conditions that mimicked (ambient pressure and temperature) shallow water artificial reef conditions (from George et al. 2005).

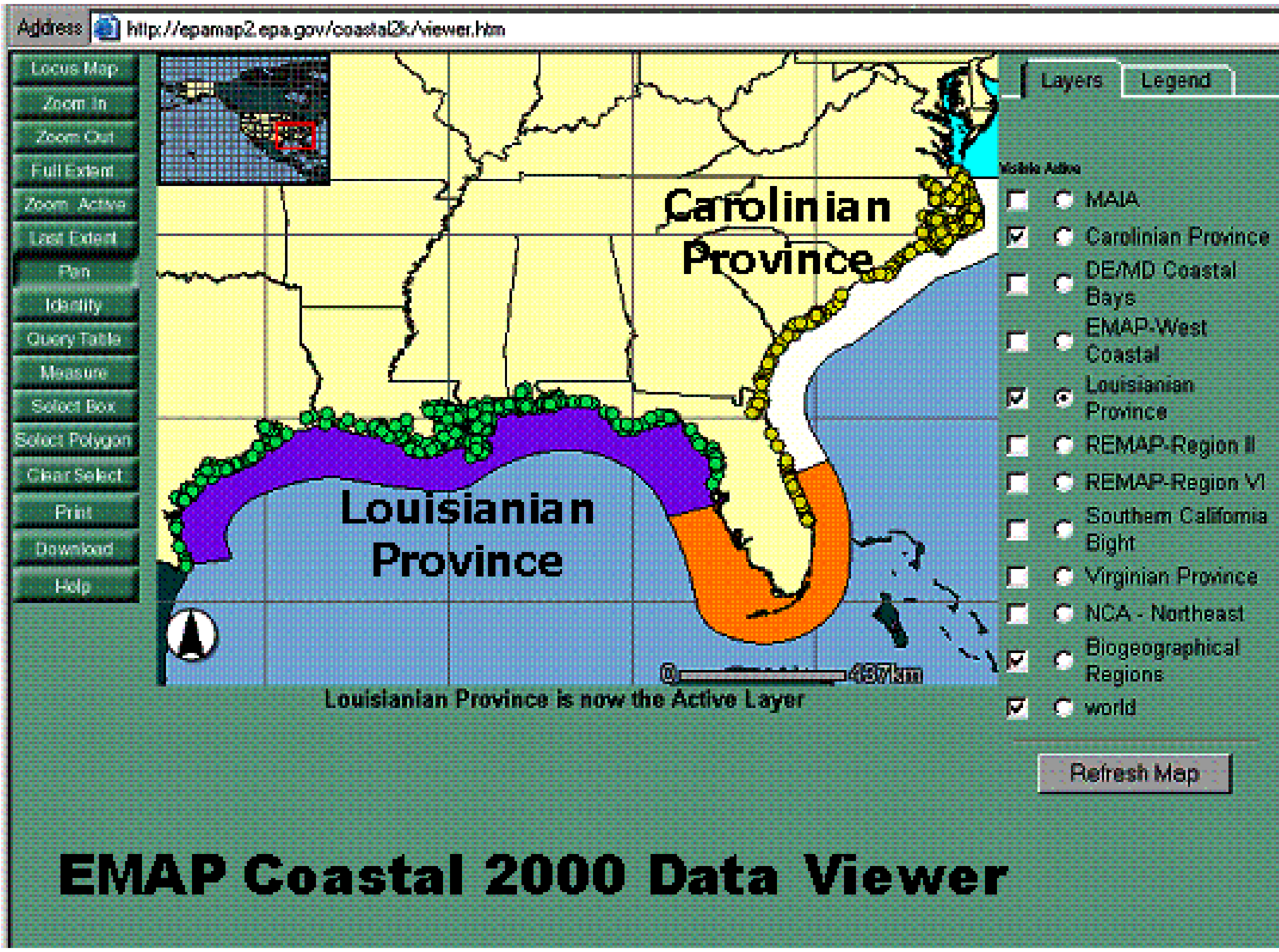


Figure 5. A screen shot of data available for coastal areas of the SE U.S. from the US EPA EMAP Program. http://epamap2.epa.gov/coastal2k/viewer.htm

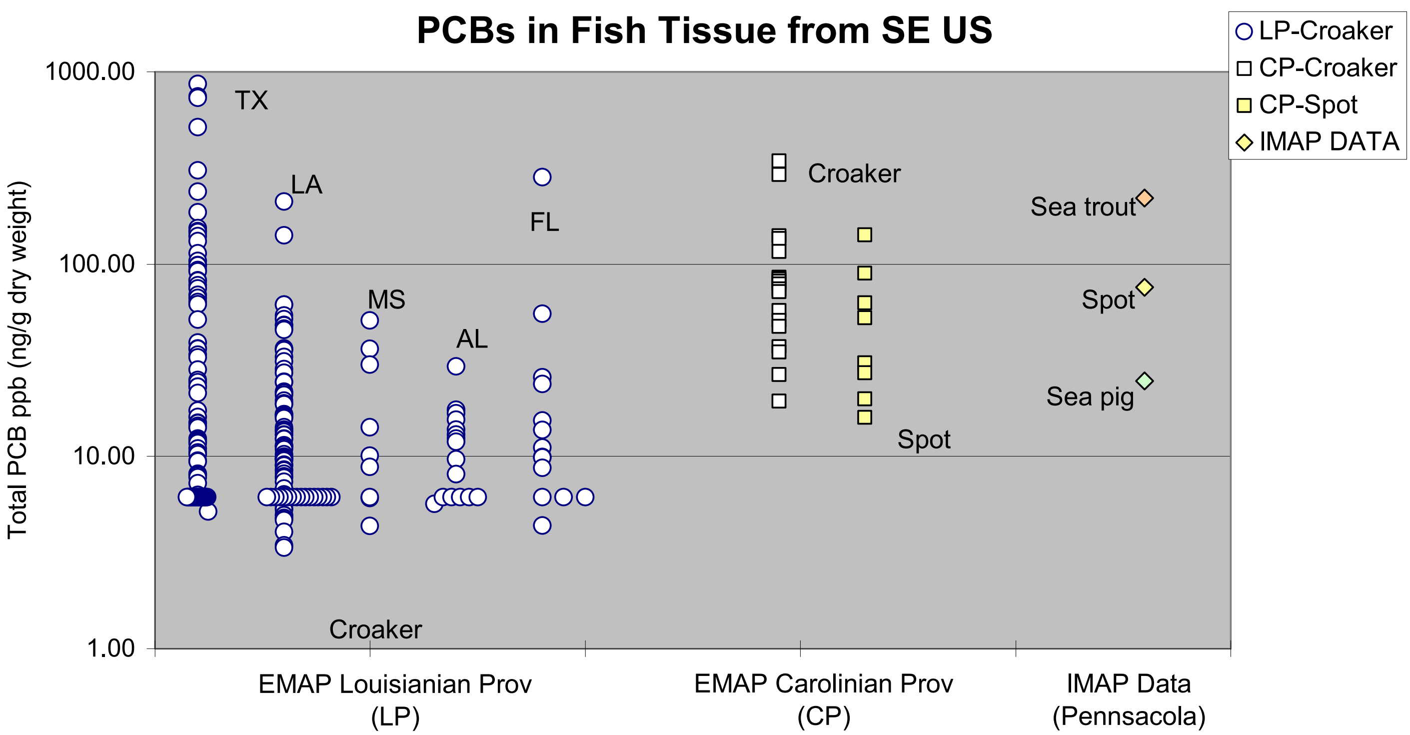


Figure 6. The range of Total PCB concentrations observed in fish tissue sampled as part of EMAP along the Gulf Coast (Louisianan Province), SE Atlantic Coast (Carolinian Province) and IMAP data for three samples collected offshore of Pensacola, Fl.

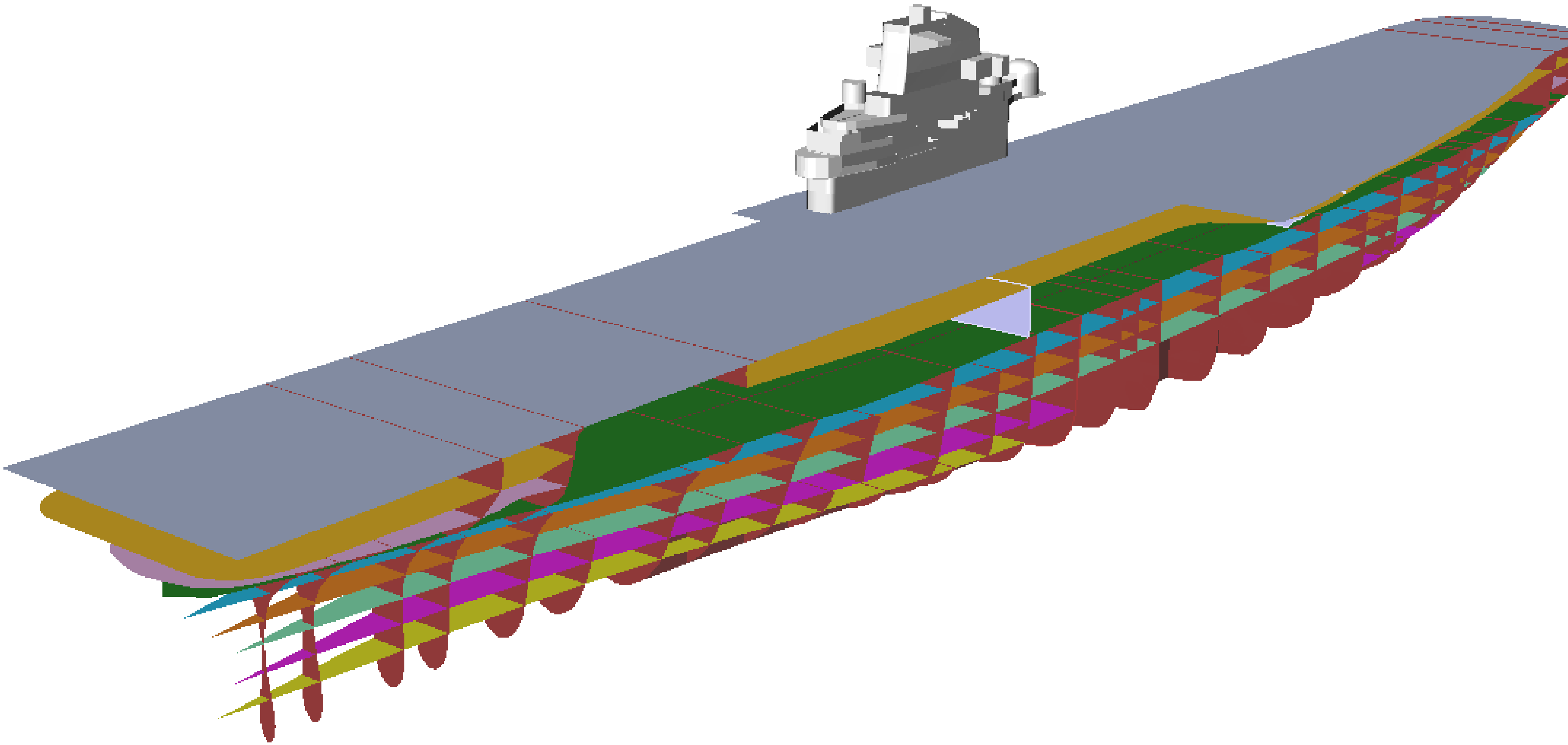


Figure 7. Computer model of the Virtual Oriskany with the shell plating removed to show decks and bulkheads (Bartlett et al. 2005).

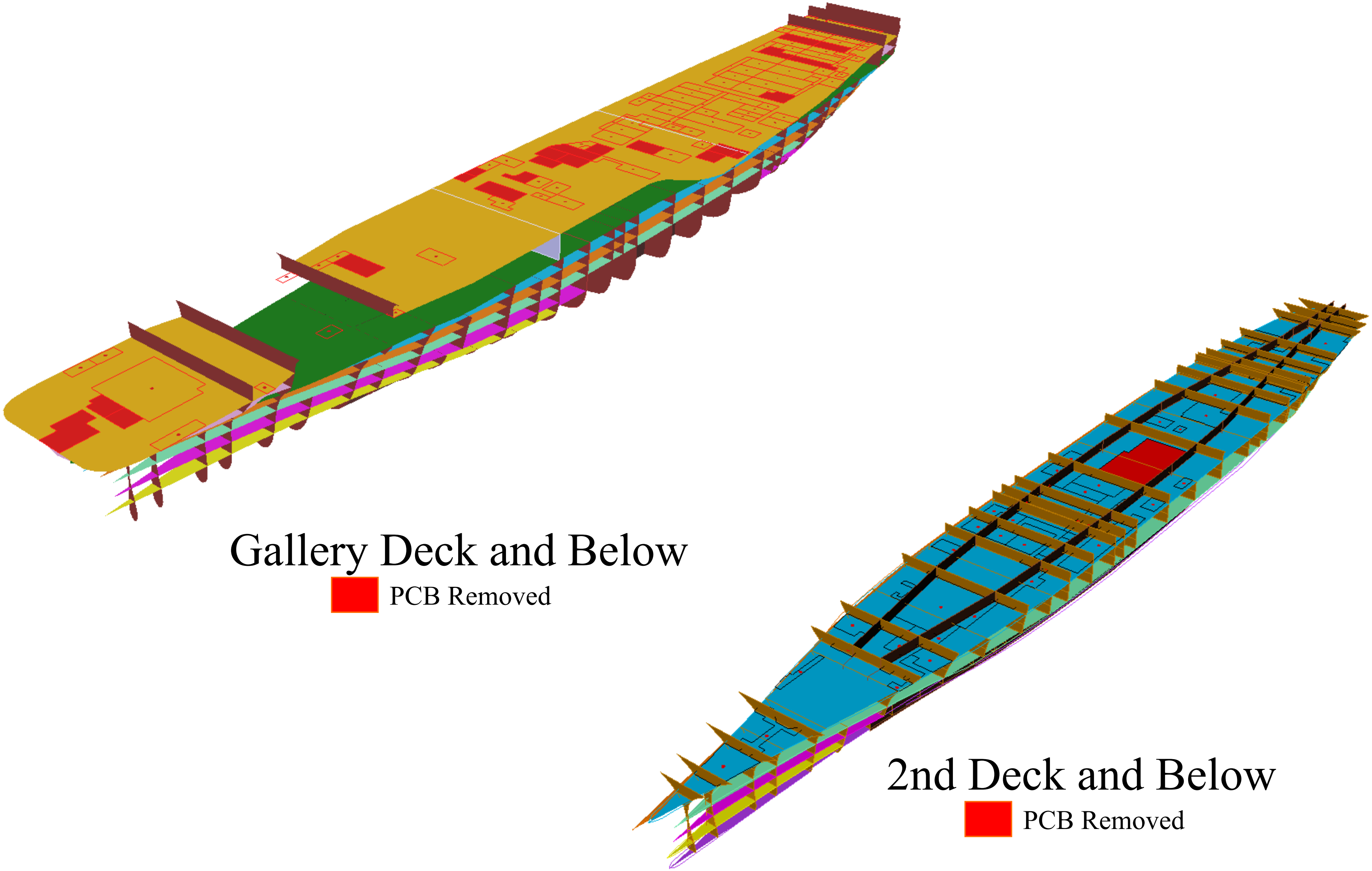


Fig. 8. Cutaway of Virtual Oriskany showing some of the areas where PCBs were removed (Bartlett et al. 2005).

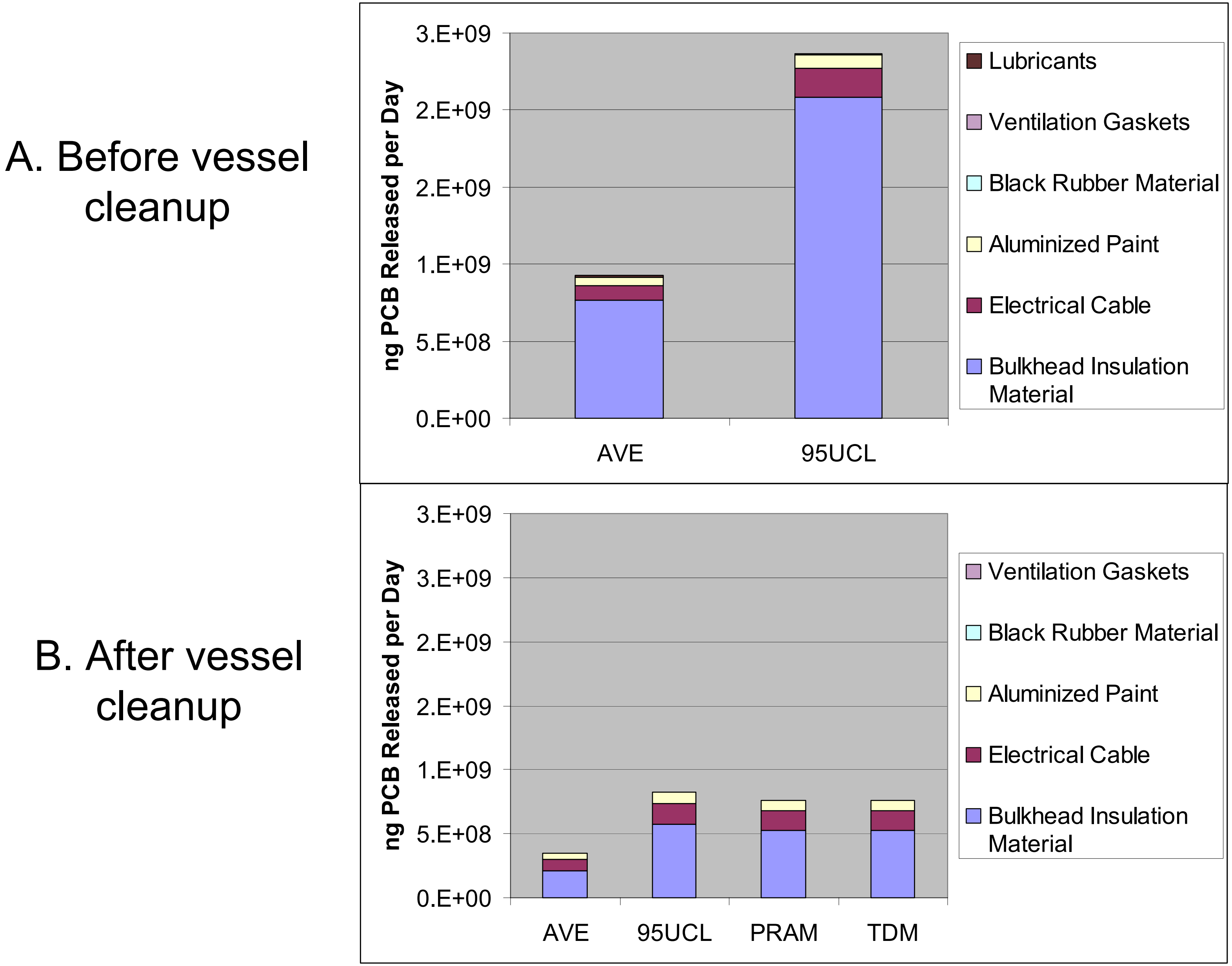


Fig. 9. The average (AVE) and 95% upper confidence level (95UCL) PCB release rates from solid materials onboard the ex-ORISKANY before (A) and after (B) vessel cleanup and the release rates used in the PRAM and TDM models.

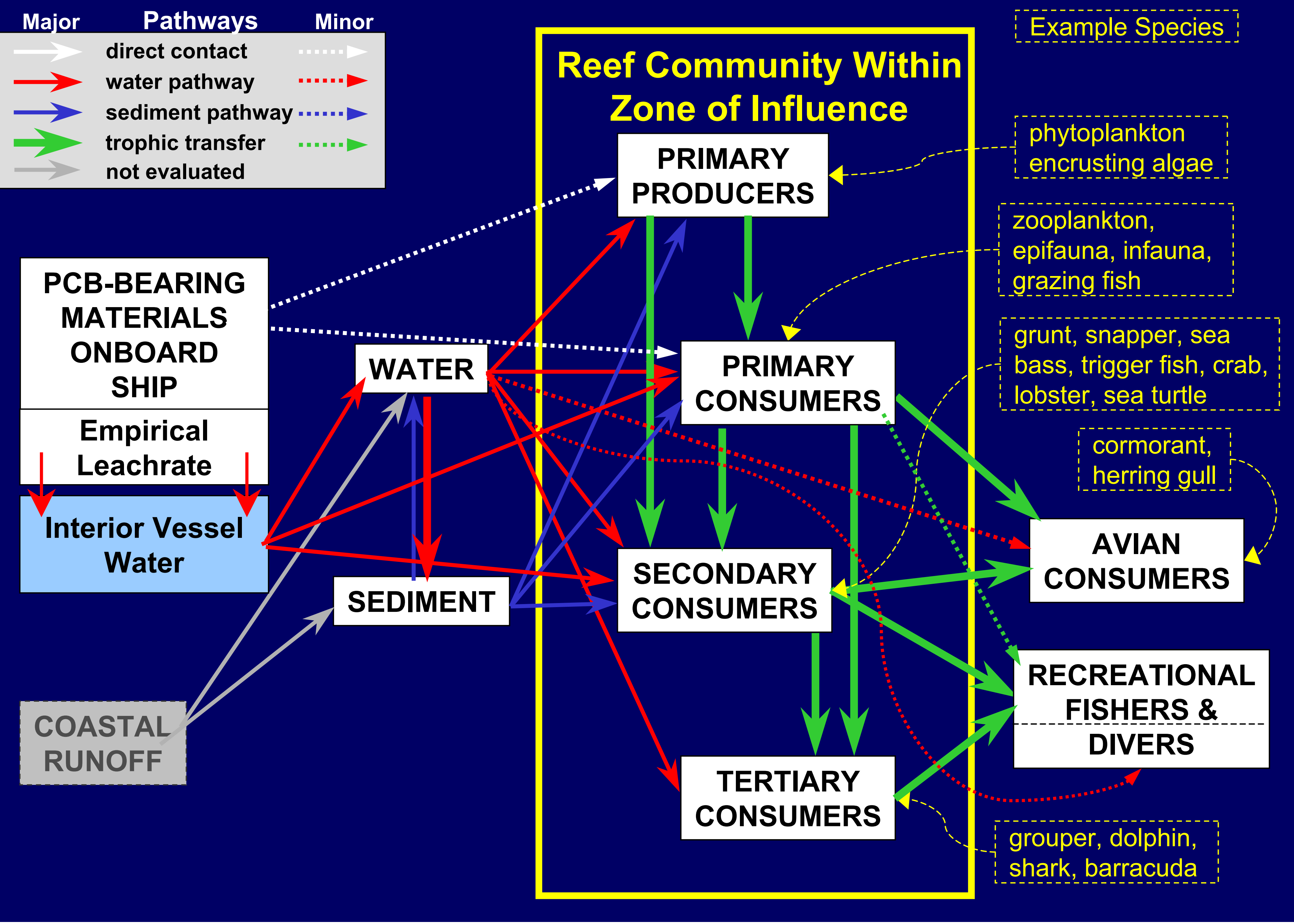


Fig. 10. The Conceptual Site Exposure Model showing the exposure pathways evaluated for the ecorisk assessment. Note that exposure to recreational fishers and divers was evaluated by the Human Health Risk Assessment.

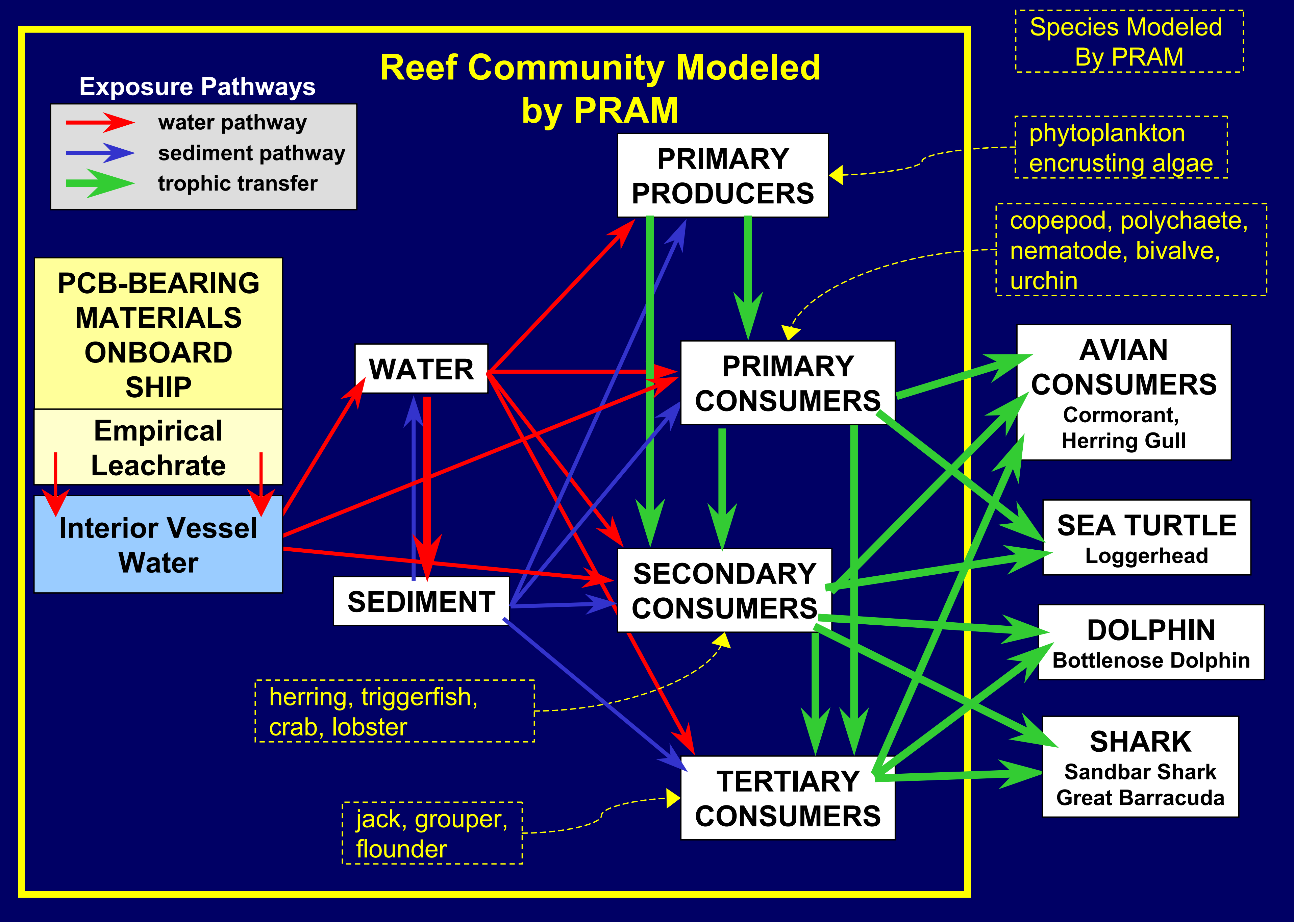


Fig. 11. The reef community modeled by PRAM and the exposure pathways (solid arrows) and assessment endpoints (white boxes) evaluated for the ecorisk assessment.

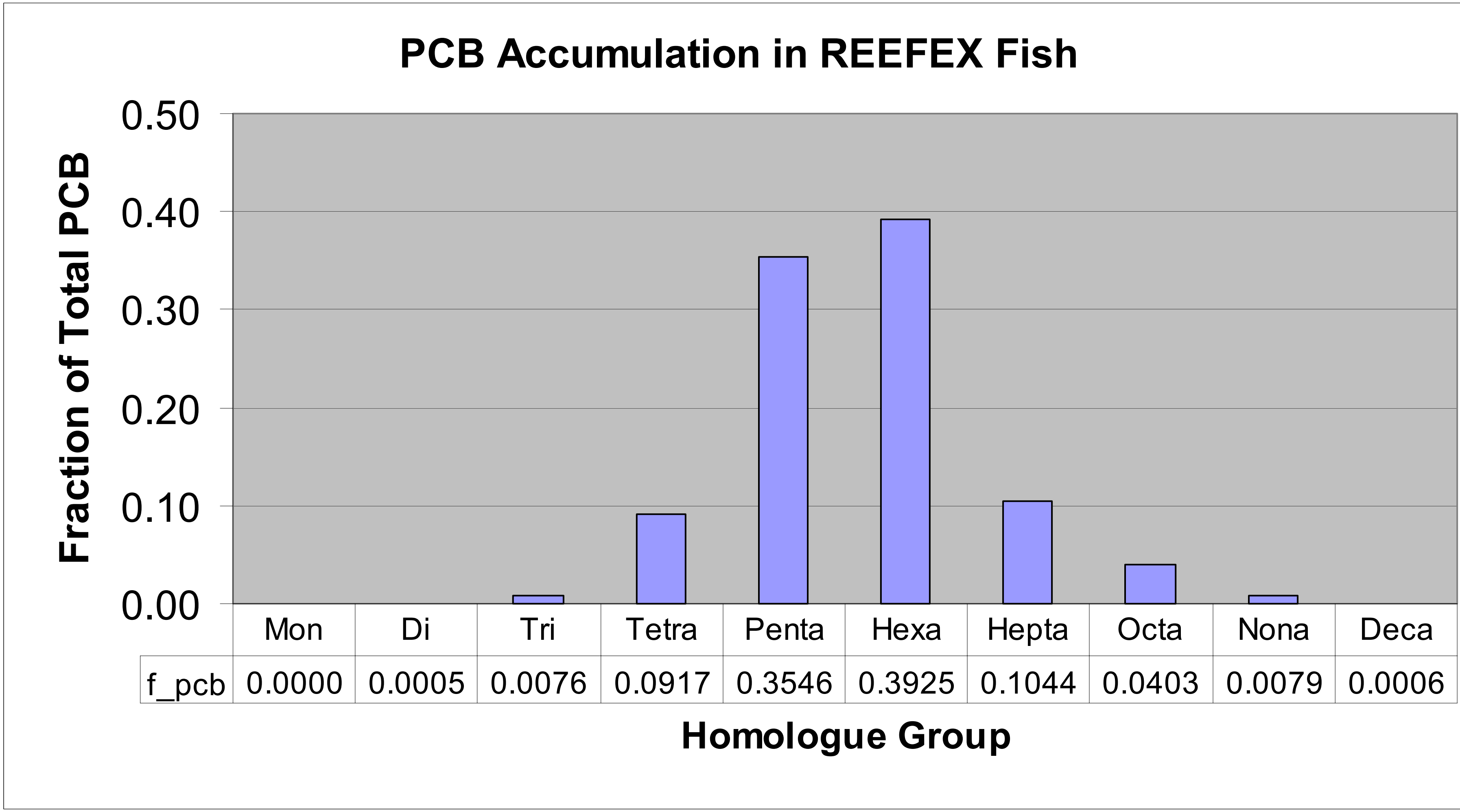


Fig. 12. Fraction of total PCB measured in each homolog group in fish collected from the ex-VERMILLION and reference reef during the REEFEX study (see Table 4).

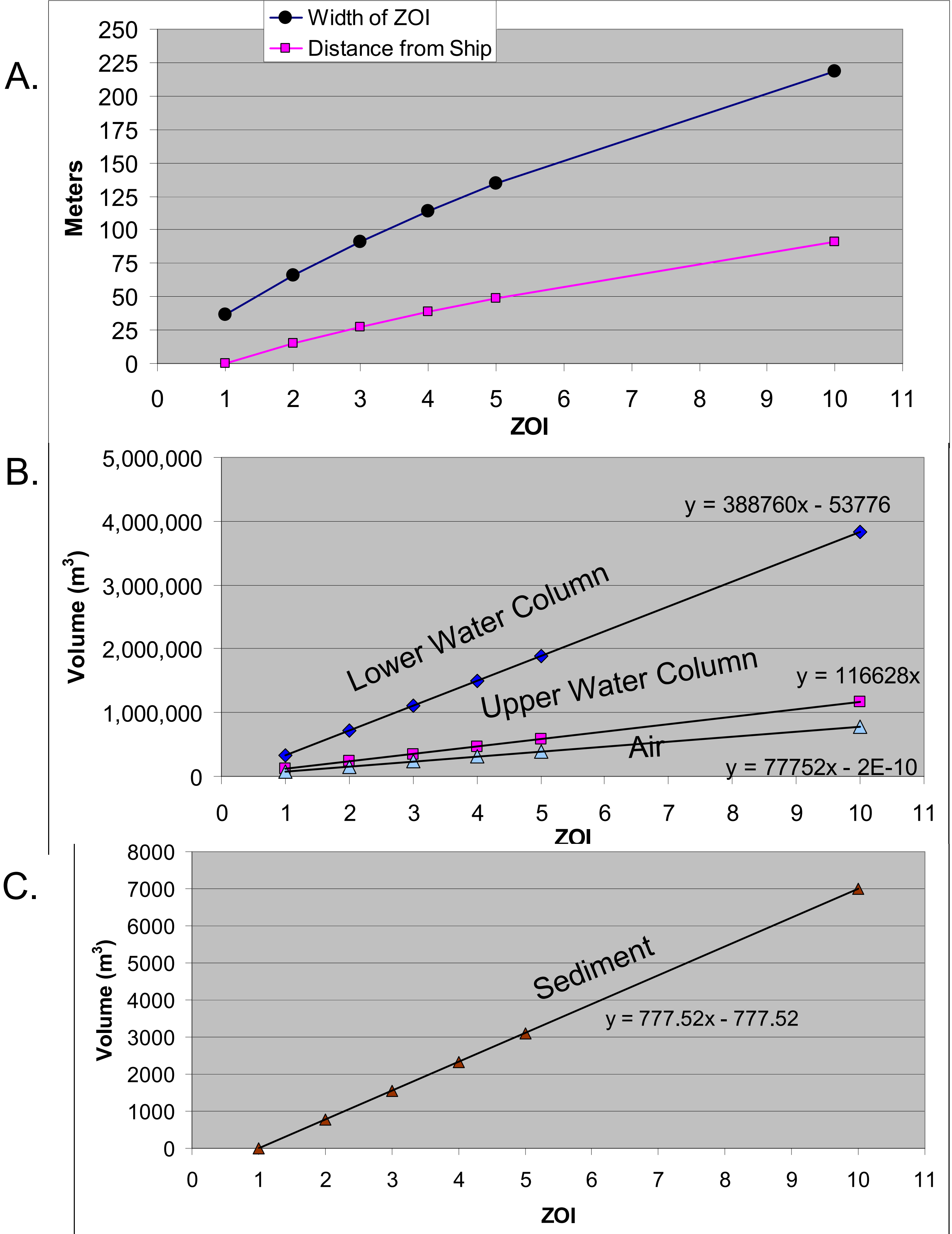


Fig. 13. The change in physical dimensions of PRAM as a function of ZOI for distance from ship (A), the volumes of the upper and lower water columns (B), and the sediment bed (C). The interior vessel volume remains constant at 5.38 x 10^4 m^3.

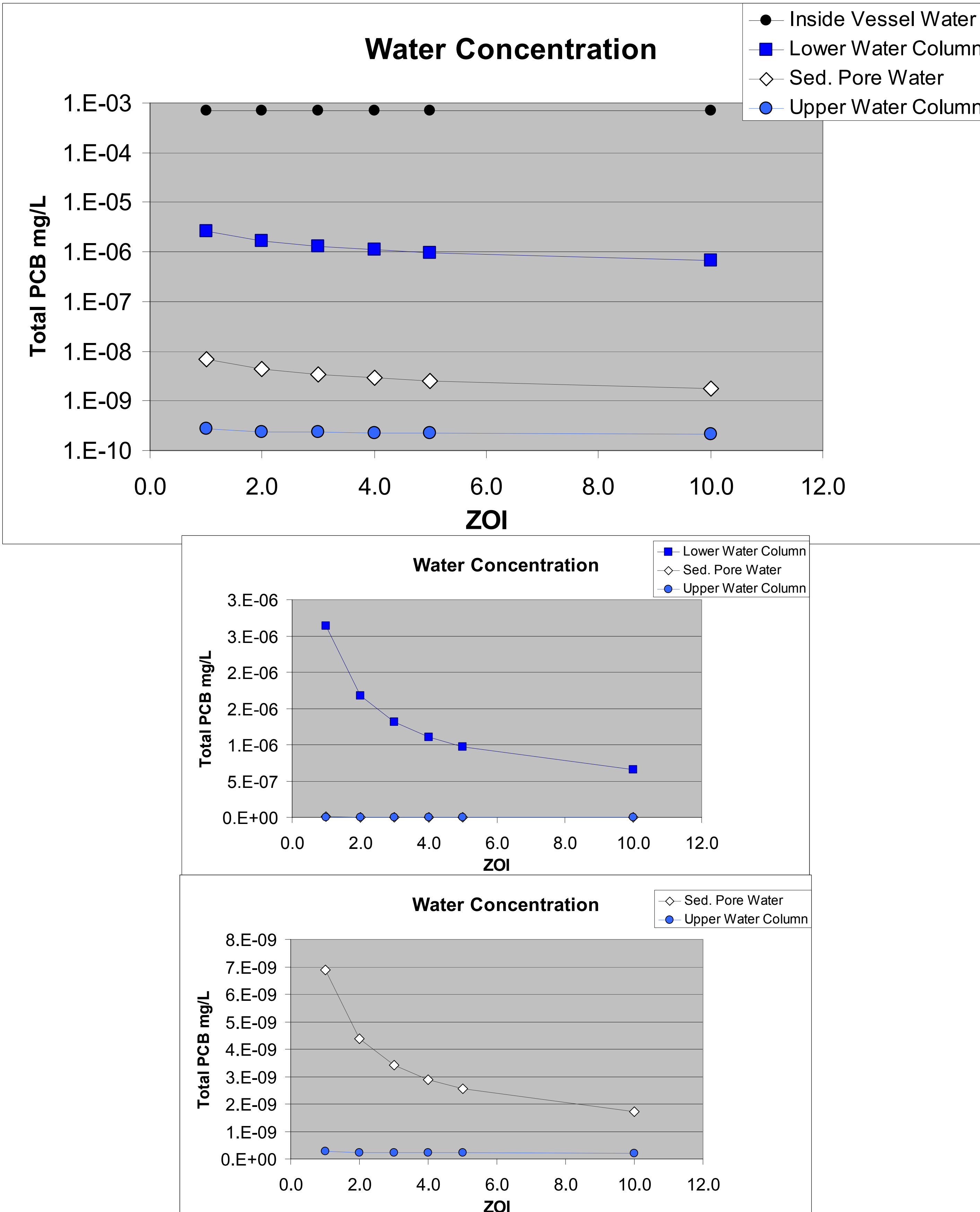
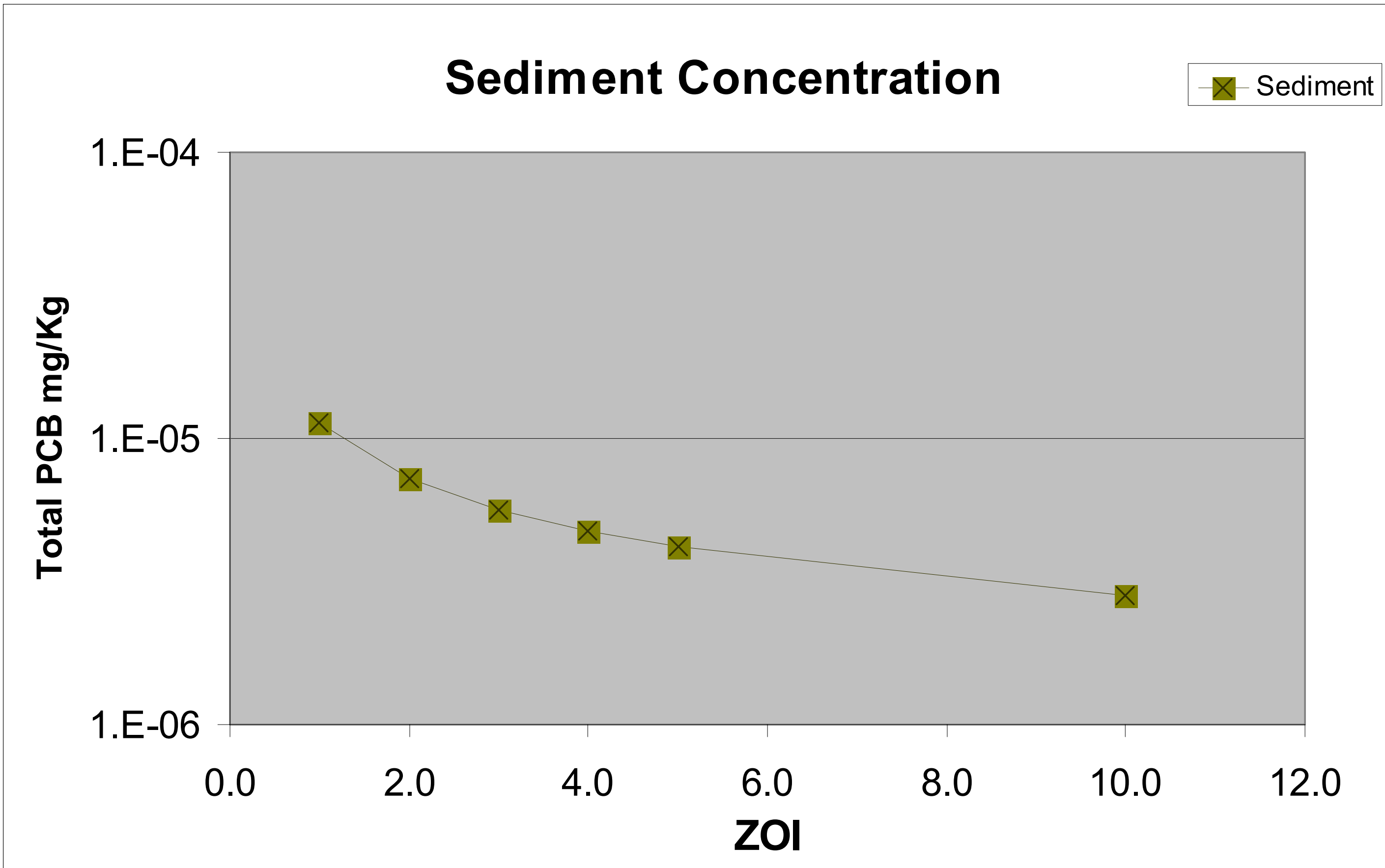


Fig. 14. Changes in Total PCB concentration in bulk water compartments in PRAM as a function of changing ZOI. Note that the concentration of Total PCB inside the vessel did not change as a function of ZOI.



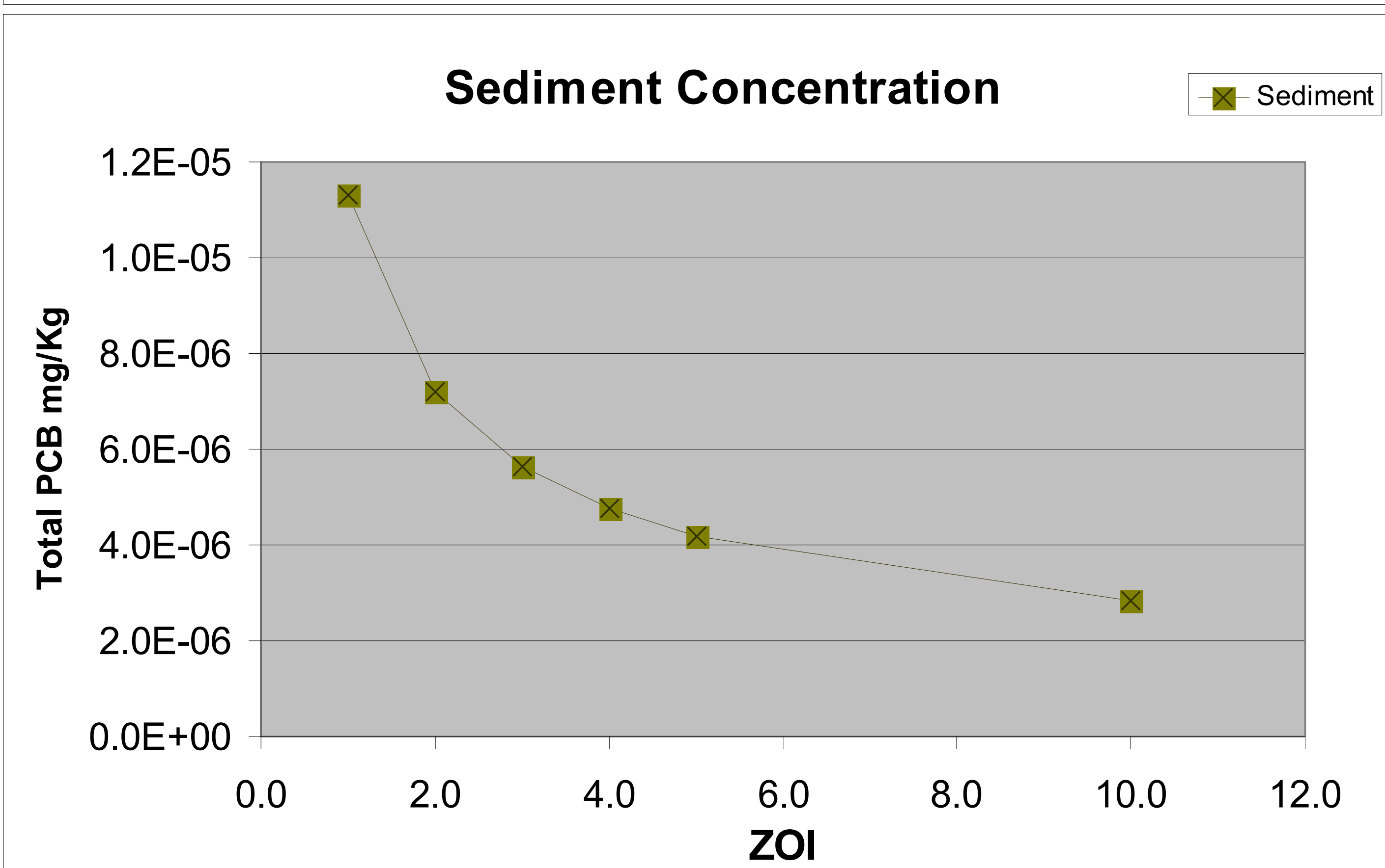
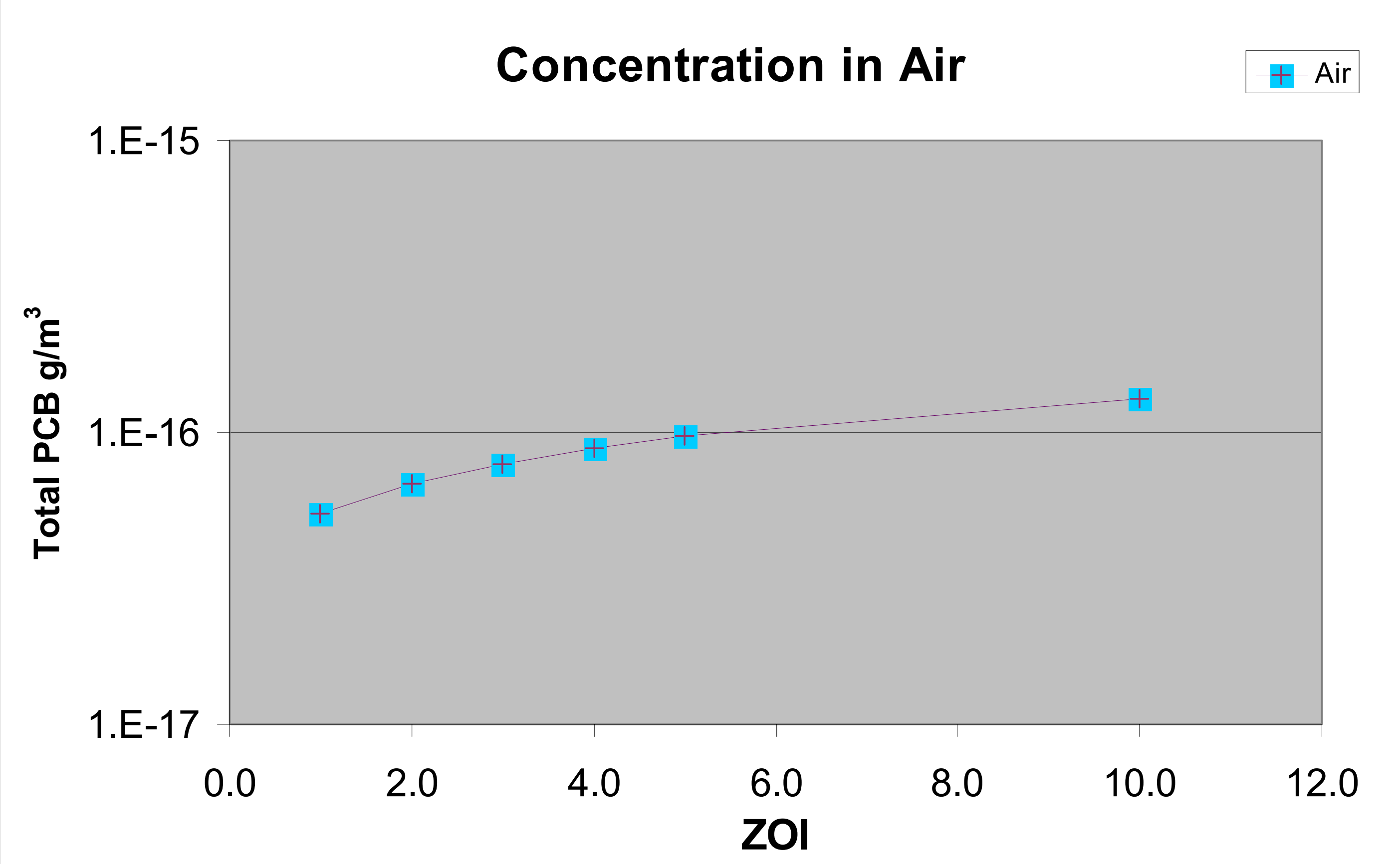


Fig. 15. Concentrations of Total PCB in the bulk sediment compartment of PRAM as a function of ZOI.



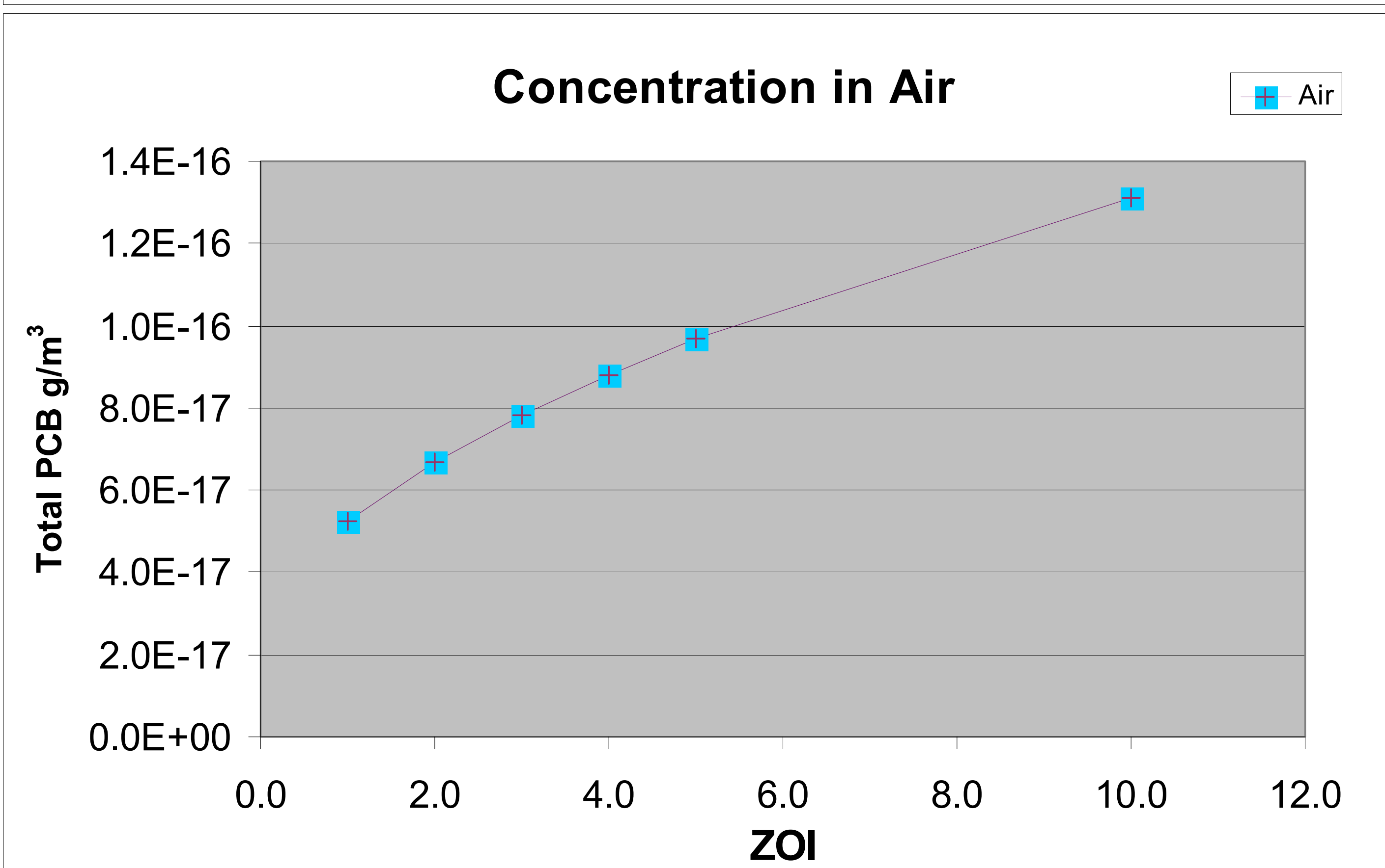


Fig. 16. The concentration of Total PCB in the air compartment of PRAM as a function of ZOI.

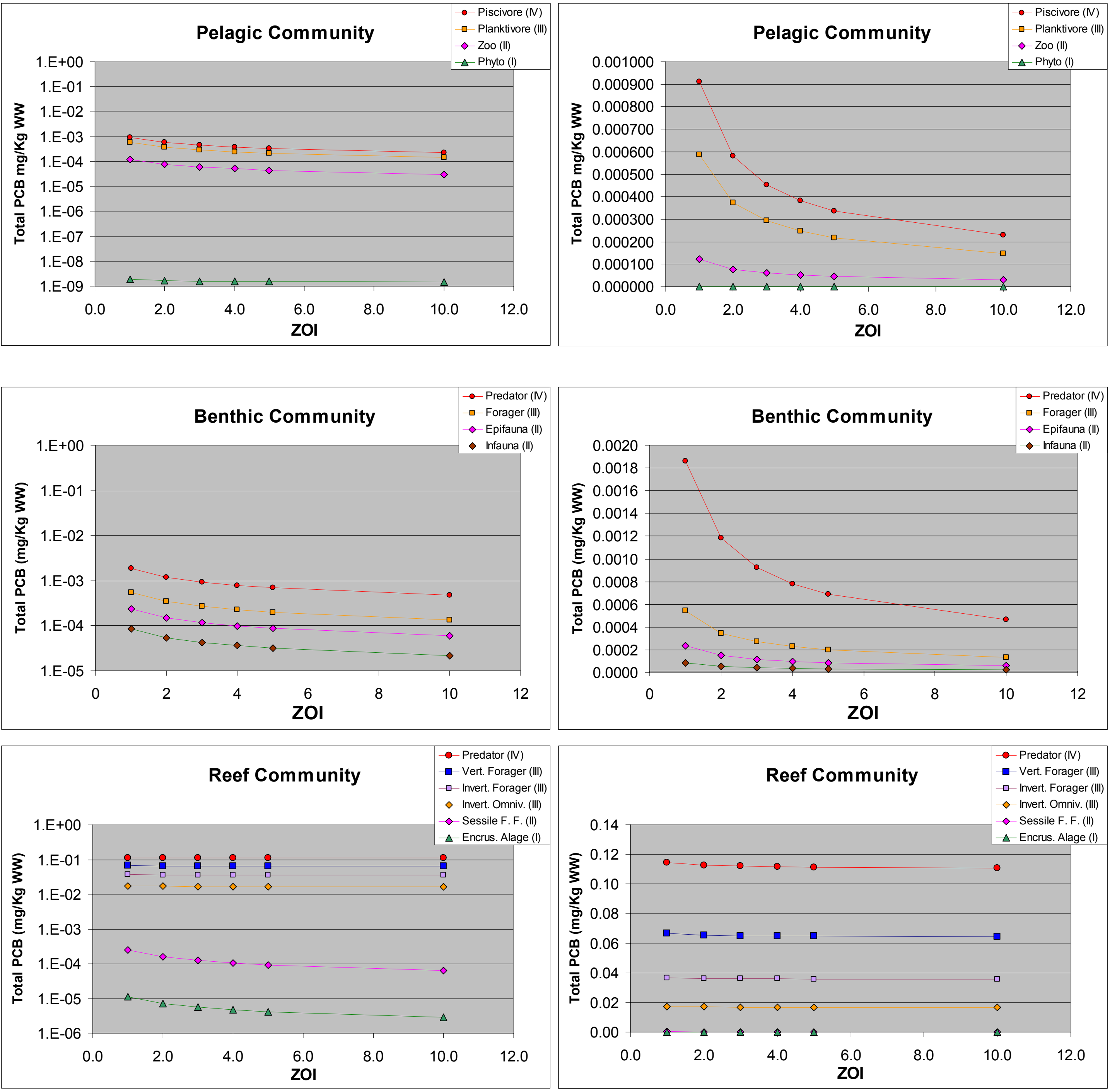


Fig. 17. Change in concentration of Total PCB in food chains of pelagic, benthic, and reef communities modeled by PRAM as a function of changes in the ZOI. Data are ploted on log (left panels) and linear (right panels) y-axes.

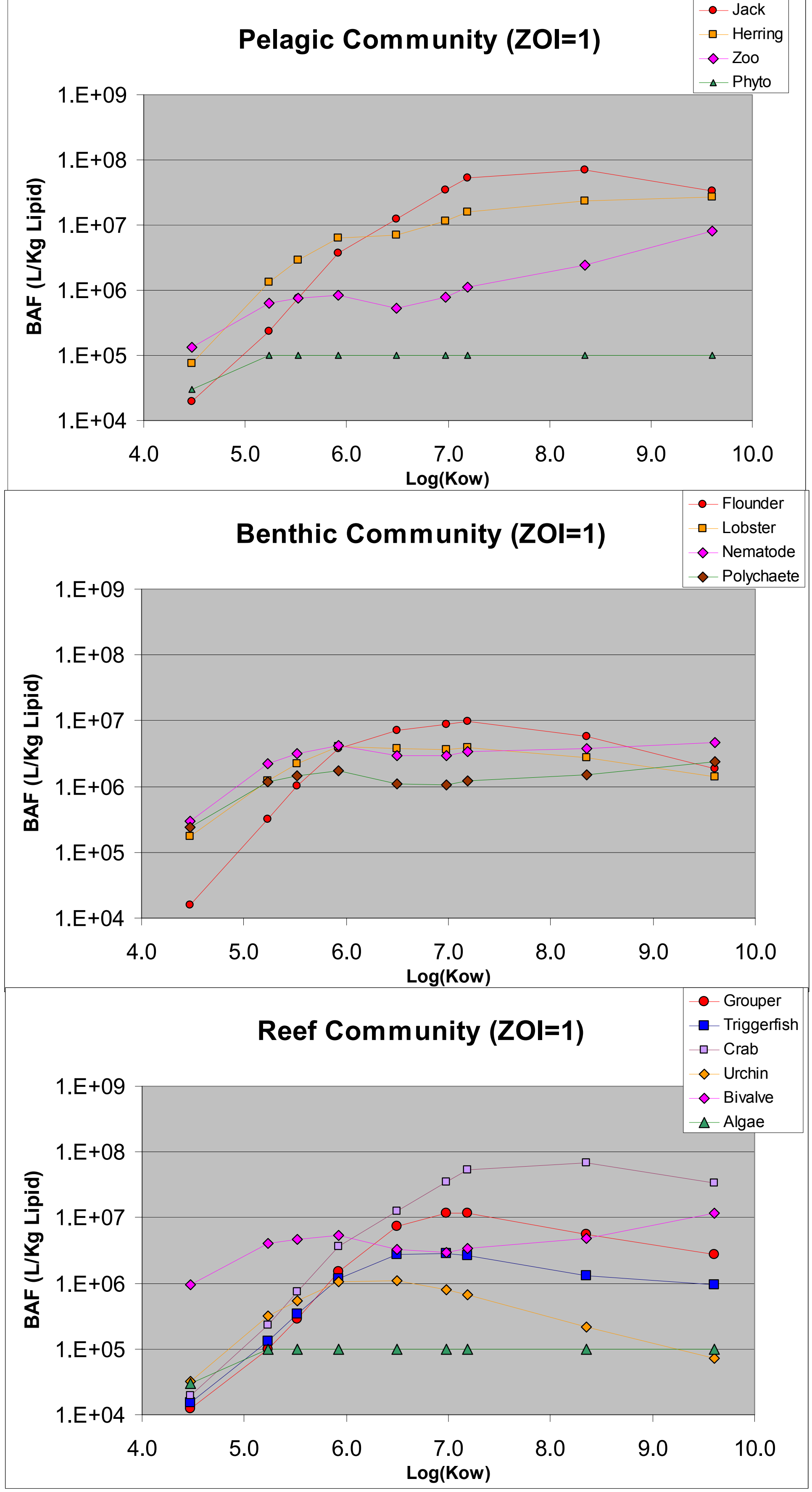


Fig. 18. The BAF obtained from PRAM with a ZOI=1 for the components of the pelagic, benthic, and reef communities as a function of Log(Kow).

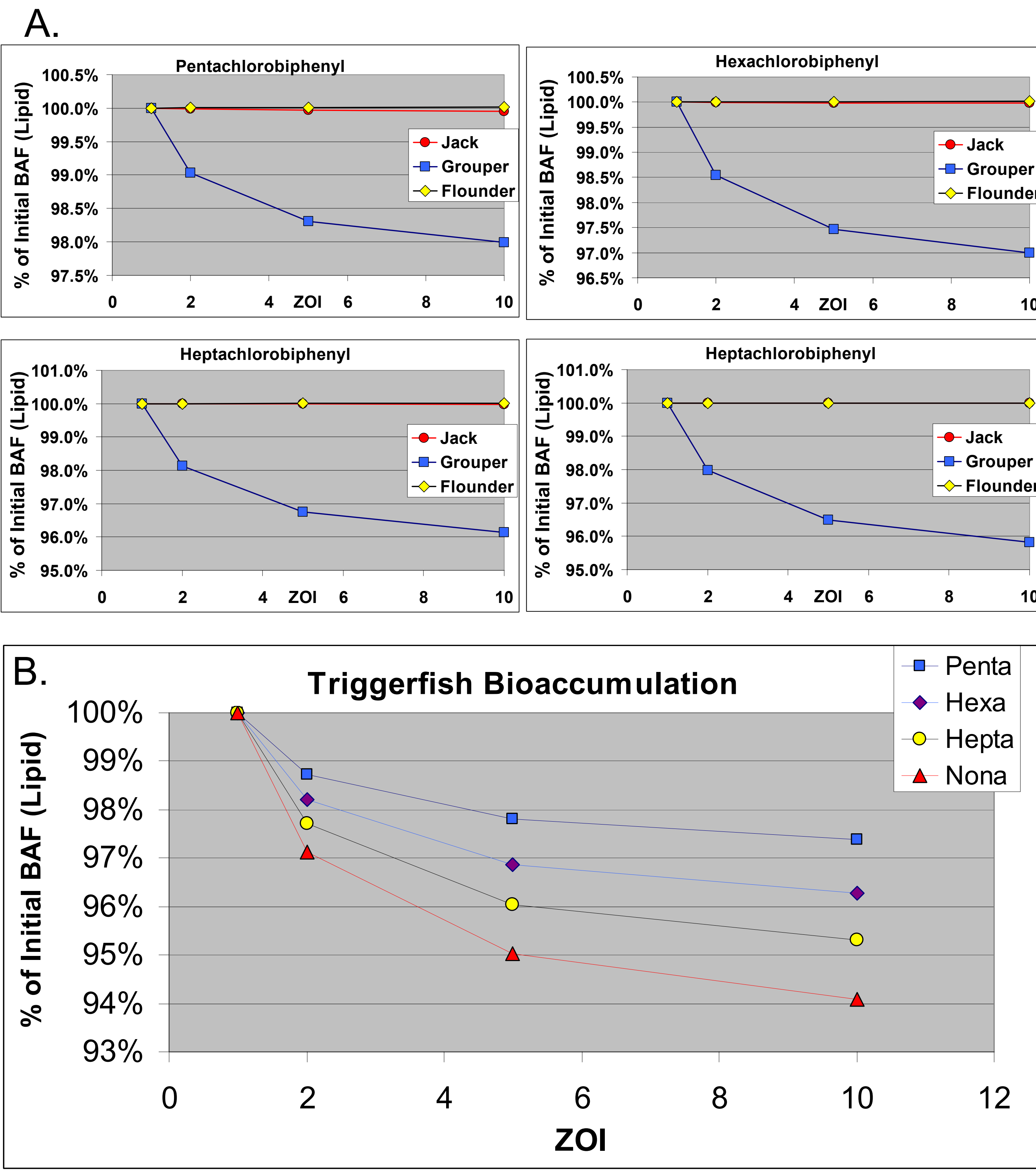


Fig. 19. Changes in the BAF (lipid-based) for the upper trophic level (TL=IV) fishes (A) and for triggerfish (TL=3, B) as a function of ZOI and homolog.

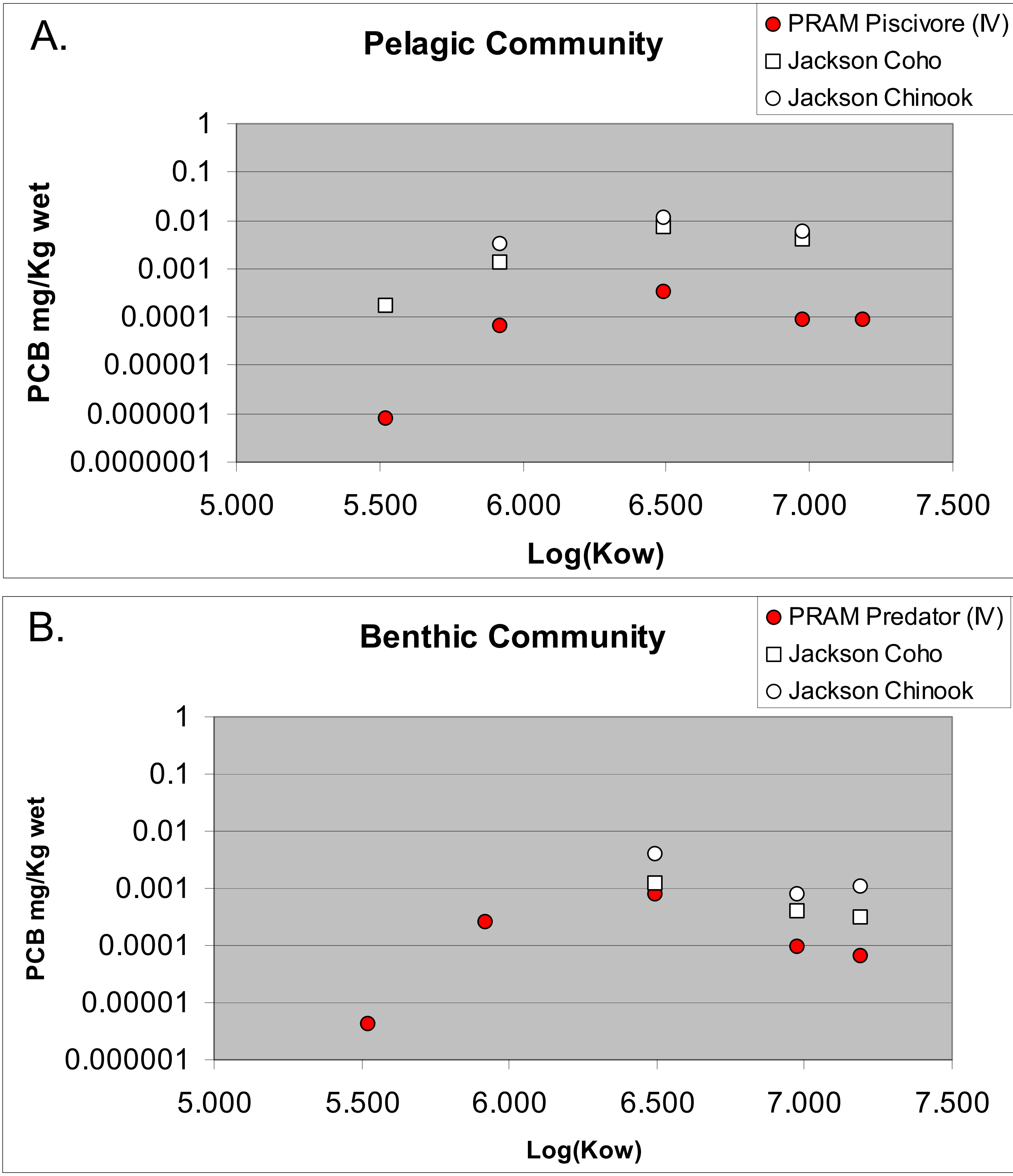


Fig. 20. PCB homolog concentrations in top predators in the pelagic and benthic food chains predicted by PRAM compared to the concentrations predicted for Coho and Chinook salmon using the slope and intercept of the regressions reported by Jackson et al. 2001.

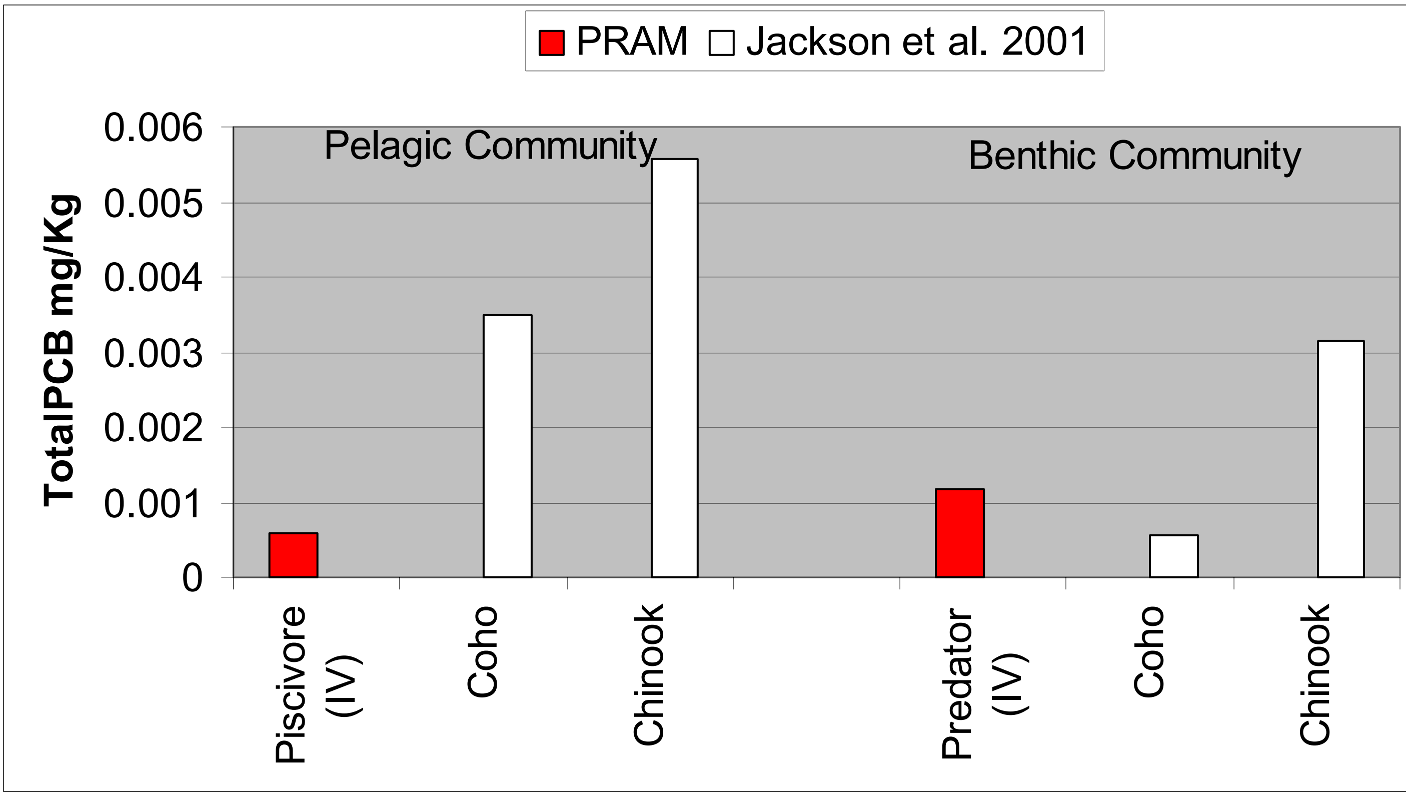
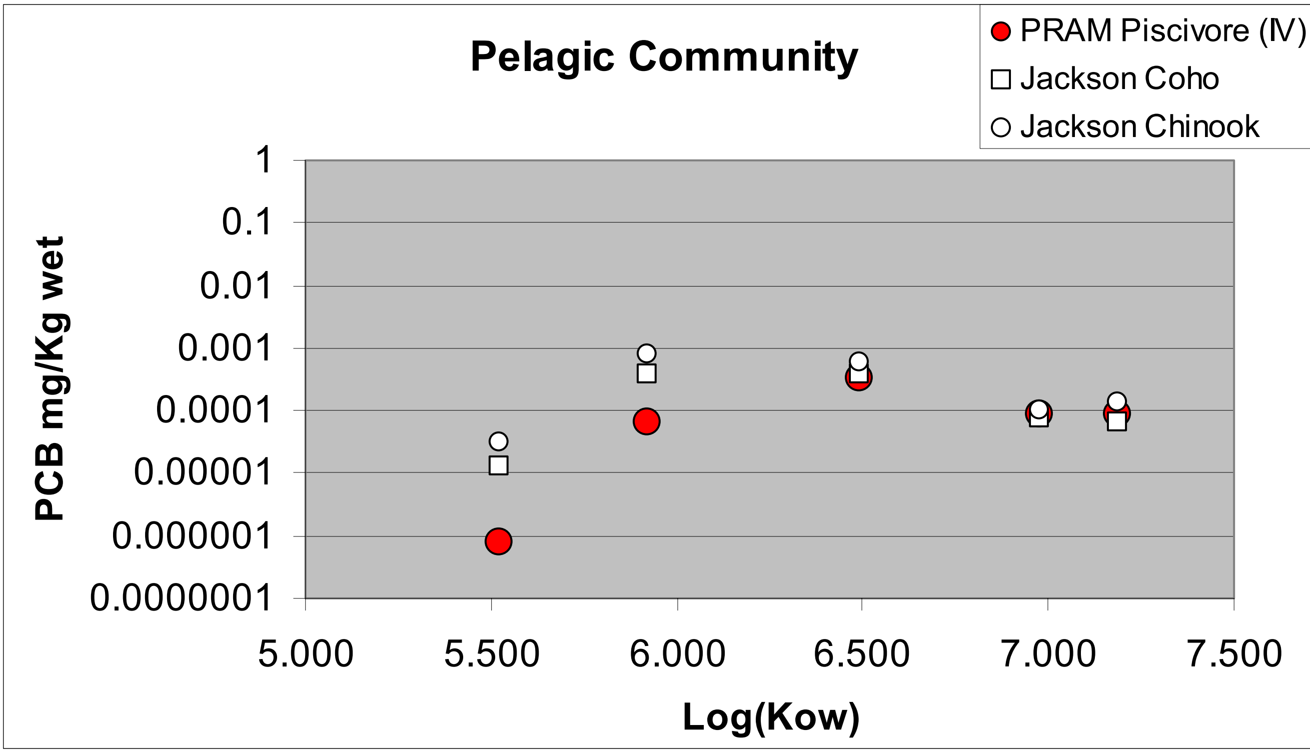


Fig. 21. Total PCB concentrations in top predators in the Pelagic and Benthic food chains predicted by PRAM compared to the concentrations predicted for Coho and Chinook salmon using the slope and intercept of the regressions reported by Jackson et al. 2001.



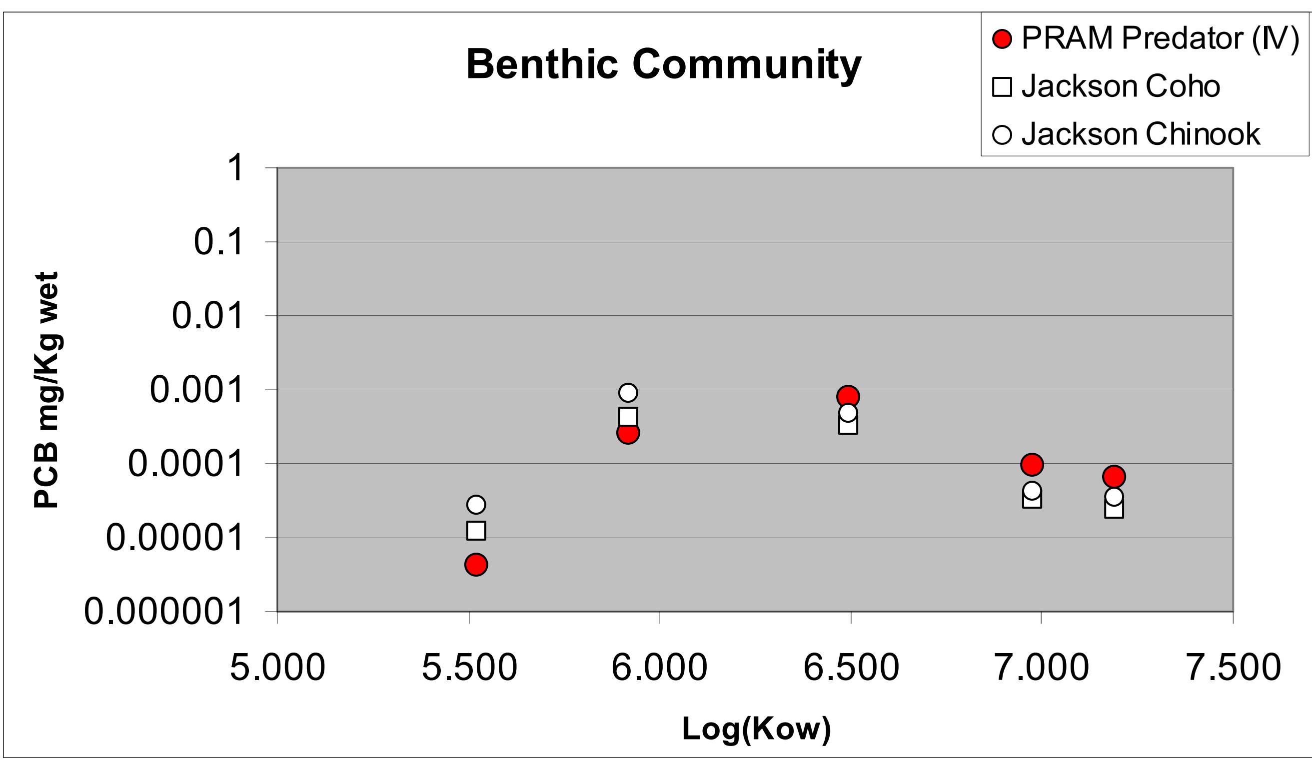


Fig. 22. PCB homolog concentrations in top predators in the Pelagic and Benthic food chains predicted by PRAM compared to the concentrations predicted for Coho and Chinook salmon using just the slope of the regressions reported by Jackson et al. 2001.

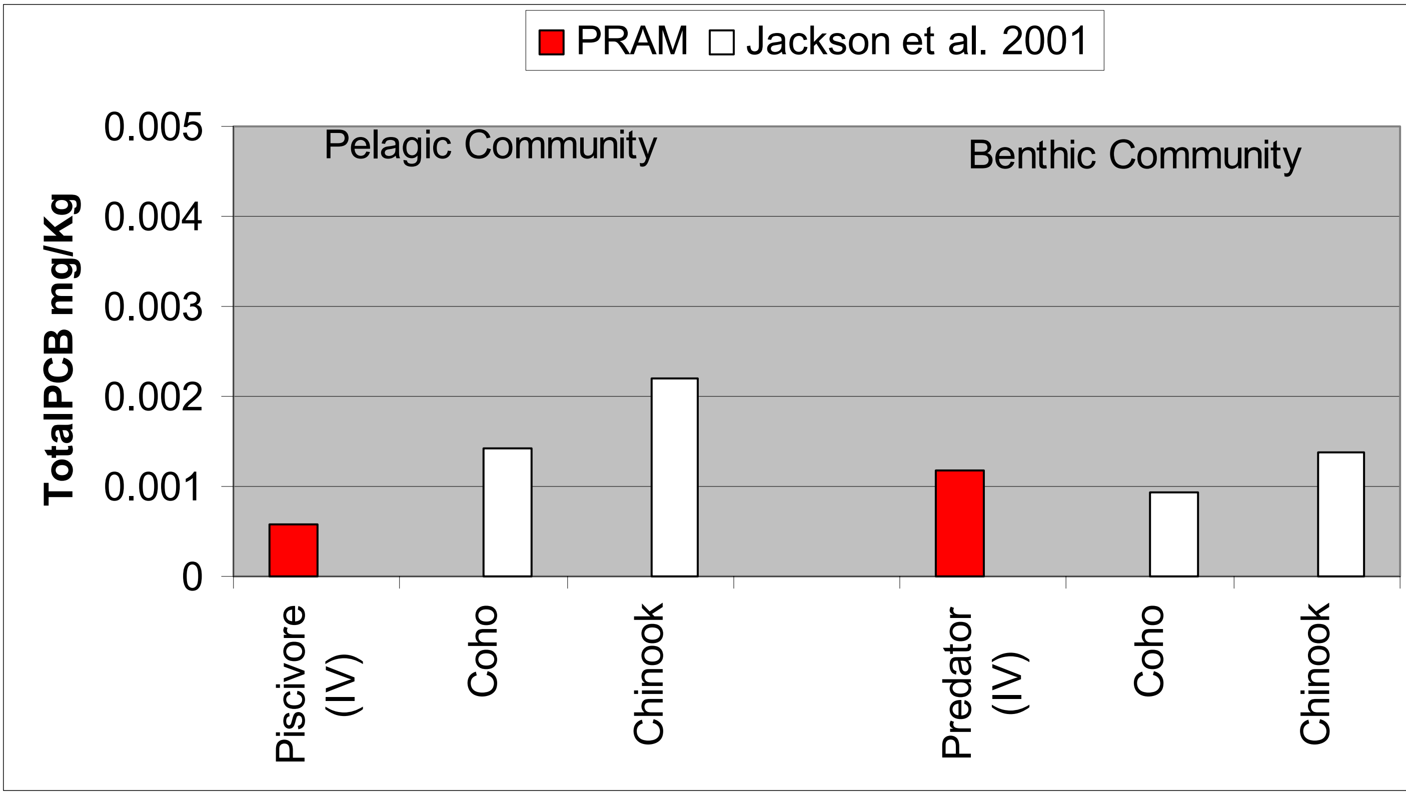


Fig. 23. Total PCB concentrations in top predators in the Pelagic and Benthic food chains predicted by PRAM compared to the concentrations predicted for Coho and Chinook salmon using just the slope of the regressions reported by Jackson et al. 2001.

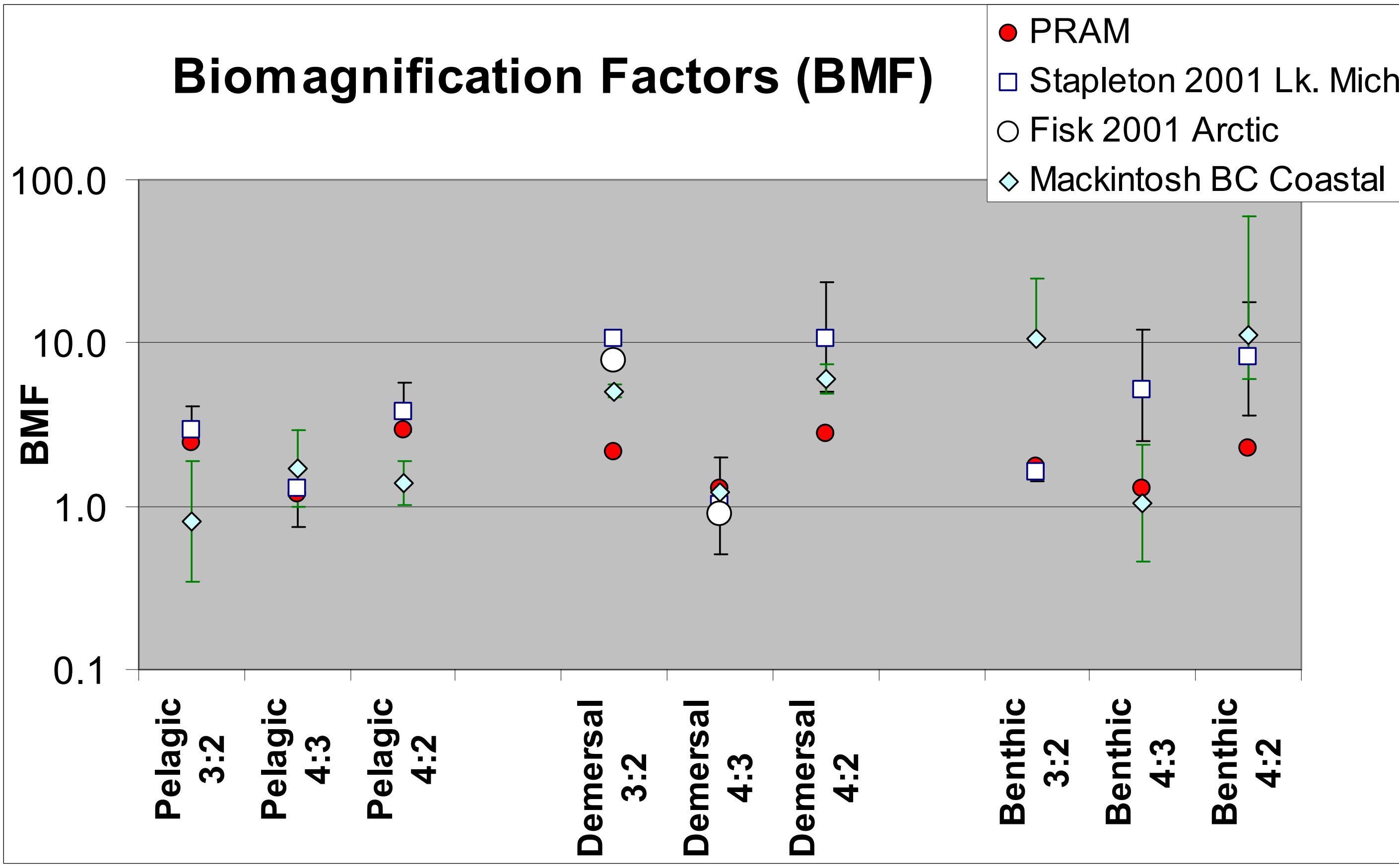


Fig. 24. Comparison of PCB biomagnification factors (BMF_{TLC}) for trophic levels 3:2, 4:3, and 4:2 predicted by PRAM and observed in pelagic, demersal, and benthic food webs from Grand Traverse Bay, Lake Michigan (Stapleton et al. 2001), False Creek Harbor, Vancouver, BC Canada (Mackintosh et al. 2004), and a demersal food web from the Northwater Polynya, Arctic (Fisk, Hobson, & Norstrom 2001).

TABLE 3. Coefficients of Variation (CV) and Average Log BAF_L^{fd} Values and Log BAF_T^{t} Values Across 13 Fish Species and Three Ecosystems for Six PCB Congeners

PCB congener	log K_{ow}	log BAF_L^{fd}	CV (%)[a]	log BAF_T^{t}	CV (%)[a]
Trophic Level 3 (9 Fish Species)					
PCB 22	5.58	6.65 ± 0.32 (48)[b]	85	4.98 ± 0.40 (46)	116
PCB 52	5.84	7.20 ± 0.28 (45)	73	5.52 ± 0.35 (45)	97
PCB 85	6.30	7.89 ± 0.27 (44)	70	5.81 ± 0.37 (44)	104
PCB 118	6.74	8.16 ± 0.25 (41)	61	5.80 ± 0.37 (44)	104
PCB 146	6.89	8.11 ± 0.34 (41)	92	6.05 ± 0.83 (28)	615
PCB 149	6.67	7.64 ± 0.24 (38)	59	5.54 ± 0.27 (41)	68
Trophic Level 4 (4 Fish Species)					
PCB 22	5.58	6.74 ± 0.32 (24)	86	5.32 ± 0.38 (23)	109
PCB 52	5.84	7.39 ± 0.28 (23)	73	5.91 ± 0.34 (23)	92
PCB 85	6.30	8.16 ± 0.27 (22)	70	6.31 ± 0.37 (22)	102
PCB 118	6.74	8.42 ± 0.24 (21)	61	6.28 ± 0.36 (22)	101
PCB 146	6.89	8.44 ± 0.36 (21)	99	6.74 ± 0.87 (15)	752
PCB 149	6.67	7.94 ± 0.26 (20)	66	6.07 ± 0.29 (21)	74

[a] Arithmetic. [b] Average ± standard deviation (number of data points).

Fig. 25. BAFs reported for PCB congeners in Burkhard et al. (2003).

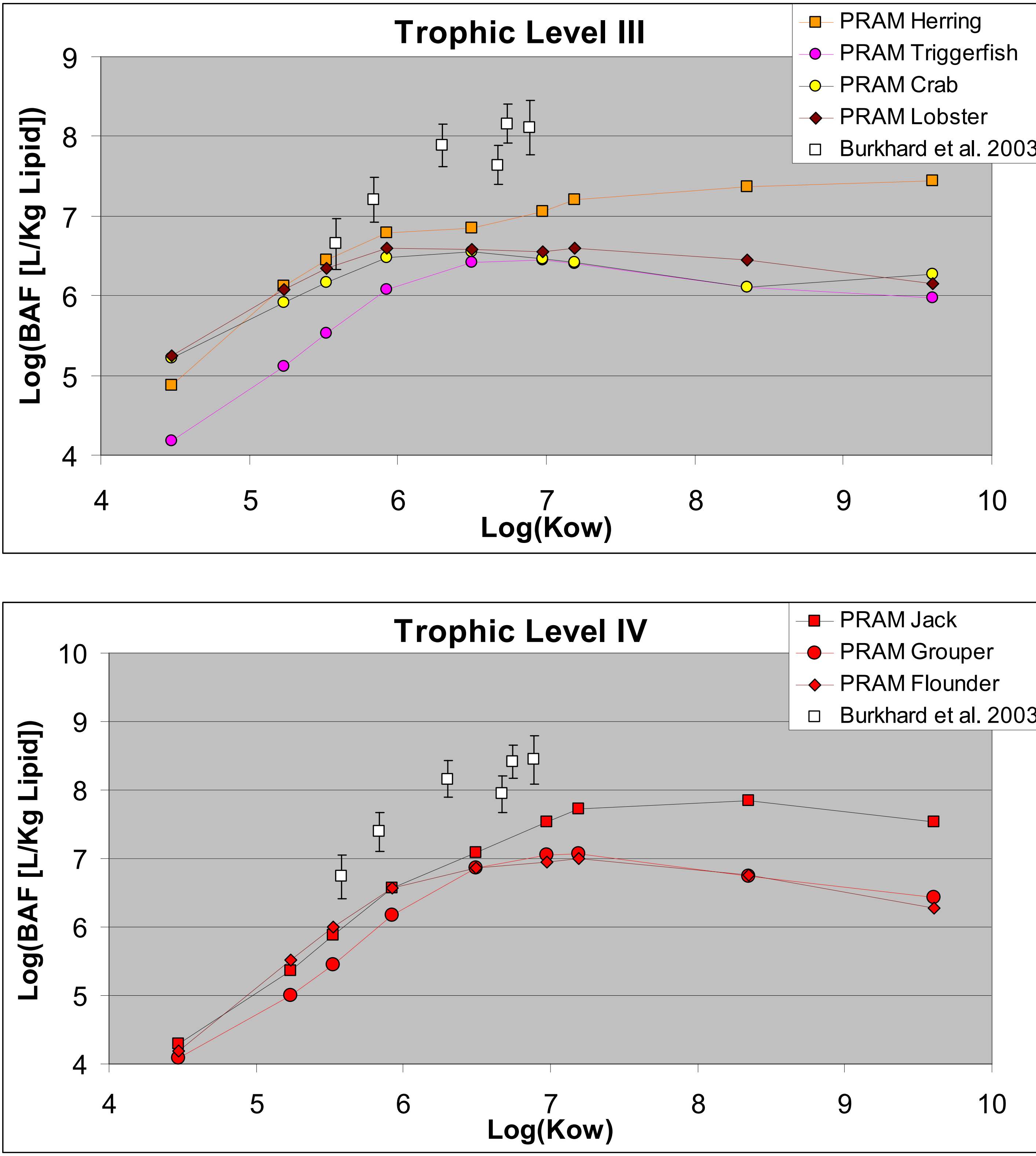


Fig. 26. Comparison of the lipid-based bioaccumulation factors (BAFs) predicted by PRAM and BAFs reported in the literature from Green Bay Lake Michigan, the Hudson River, and Lake Ontario for Trophic Level III (A) and Trophic Level IV (B) predators.

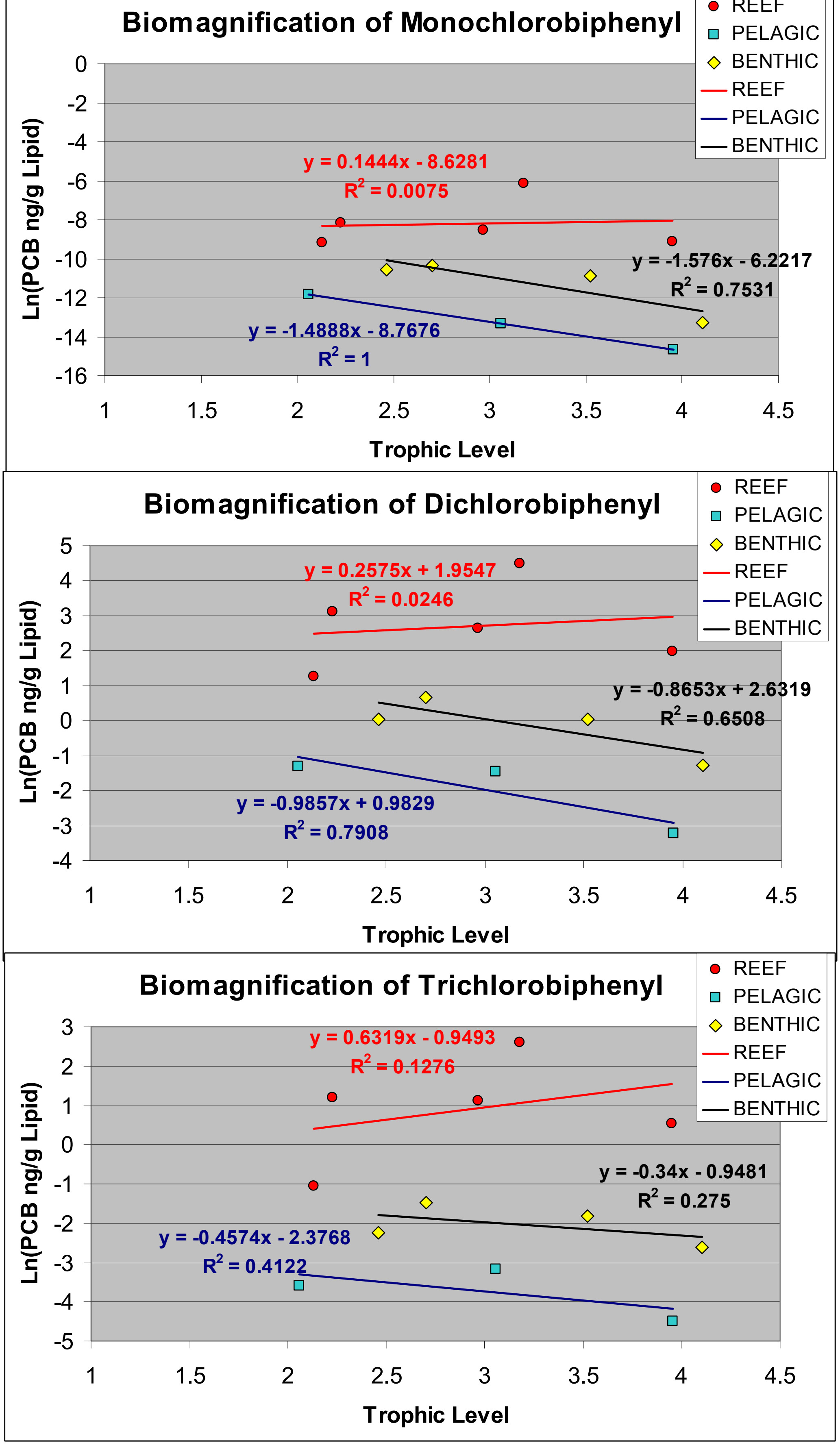


Fig. 27. Biomagnification of mono-, di-, and trichlorobiphenyl predicted by PRAM.

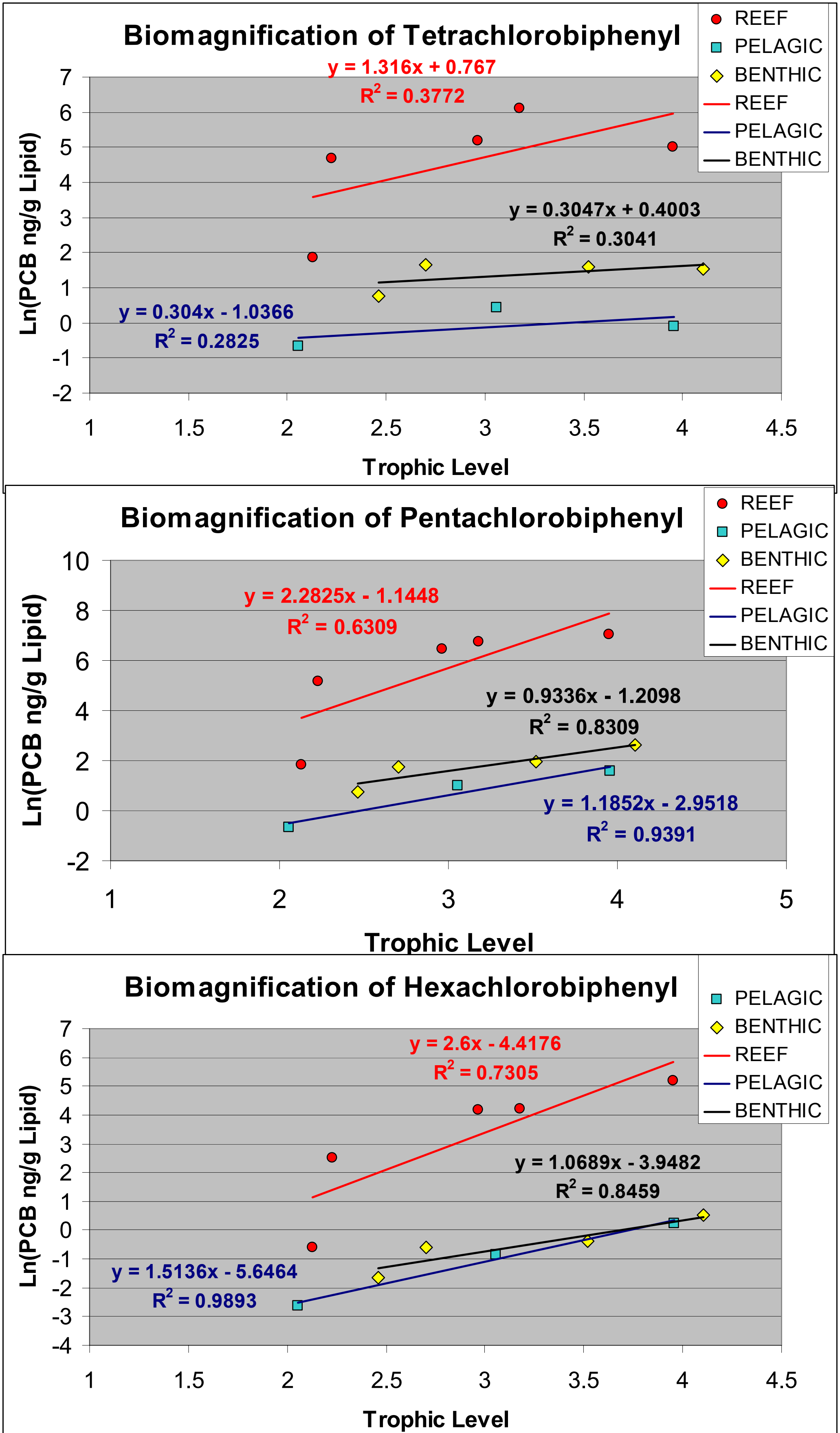


Fig. 28. Biomagnification of tetra-, penta-, and hexachlorobiphenyl predicted by PRAM.

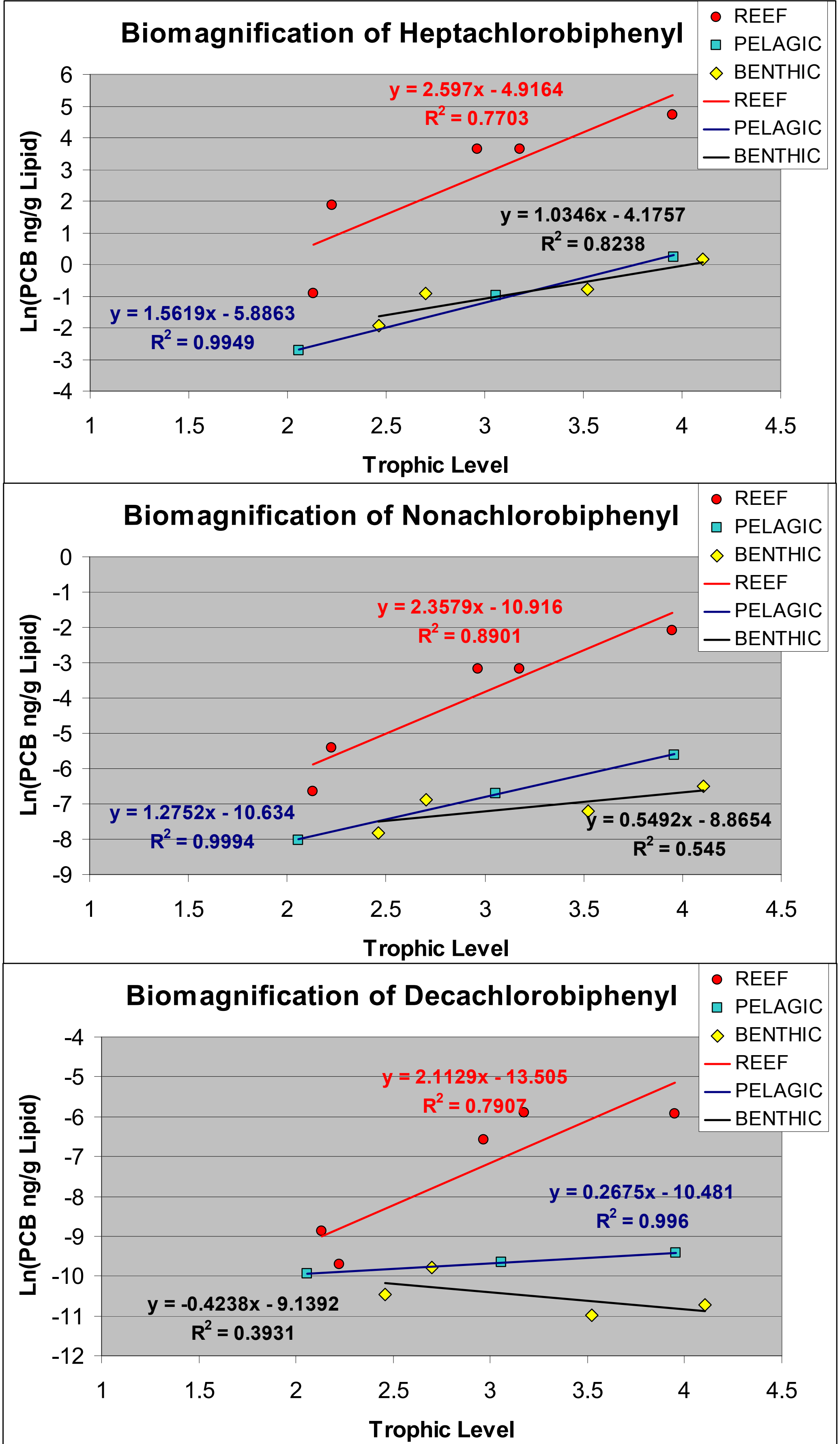
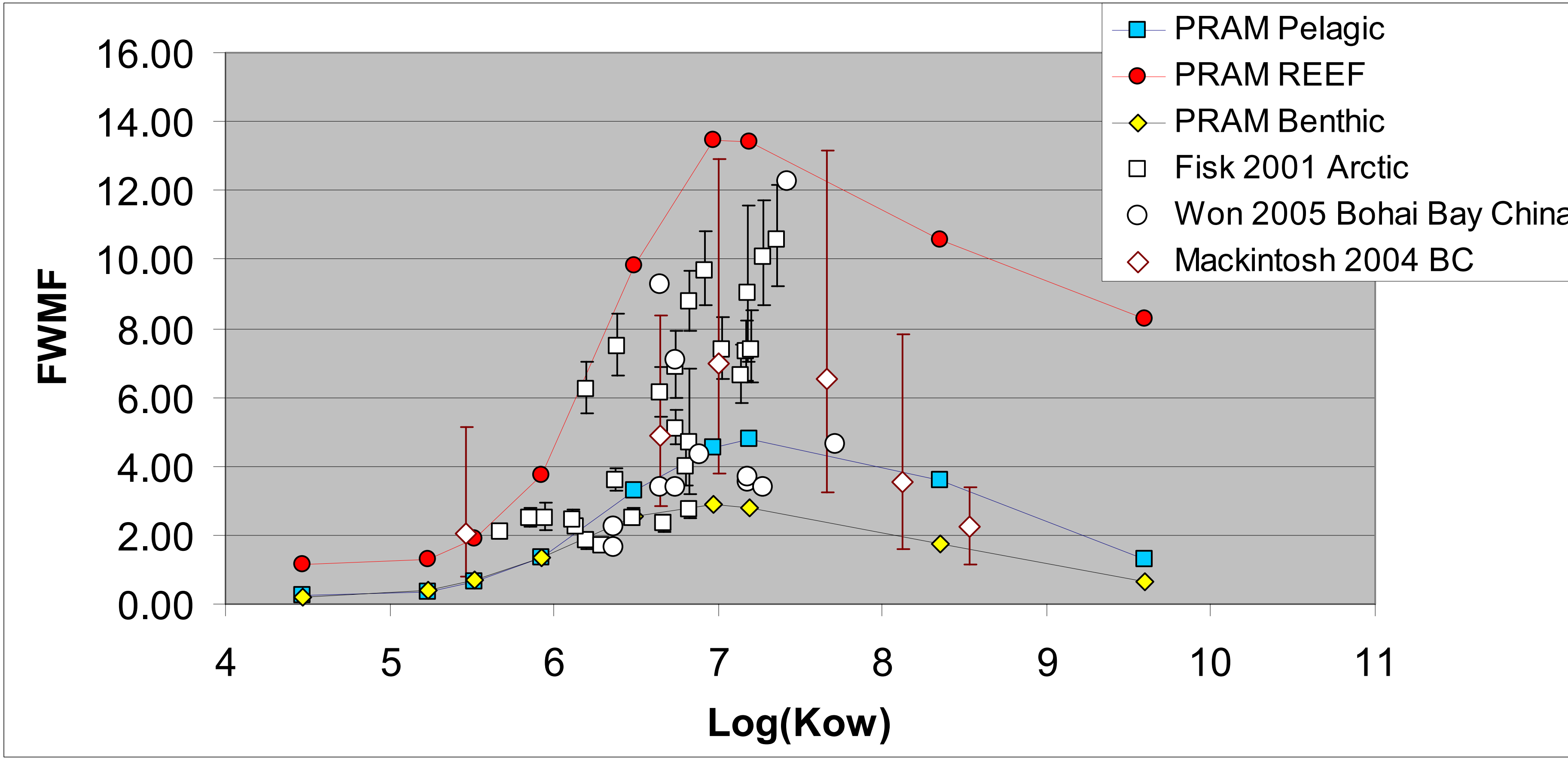


Fig. 29. Biomagnification of hepta-, nona-, and decachlorobiphenyl predicted by PRAM.



error bars on Mackintosh 2004 are 95th% CL
error bars on Fisk 2001 are +/- 1 Std error

Fig. 30. Comparison of the food web magnification factor (FWMF) predicted by PRAM for the pelagic, reef, and benthic communities and the FWMF reported in the literature for food webs from the Arctic (Fisk et al. 2001), Bohai Bay, China (Wan et al. 2005), and coastal British Columbia (Mackintosh et al. 2004).

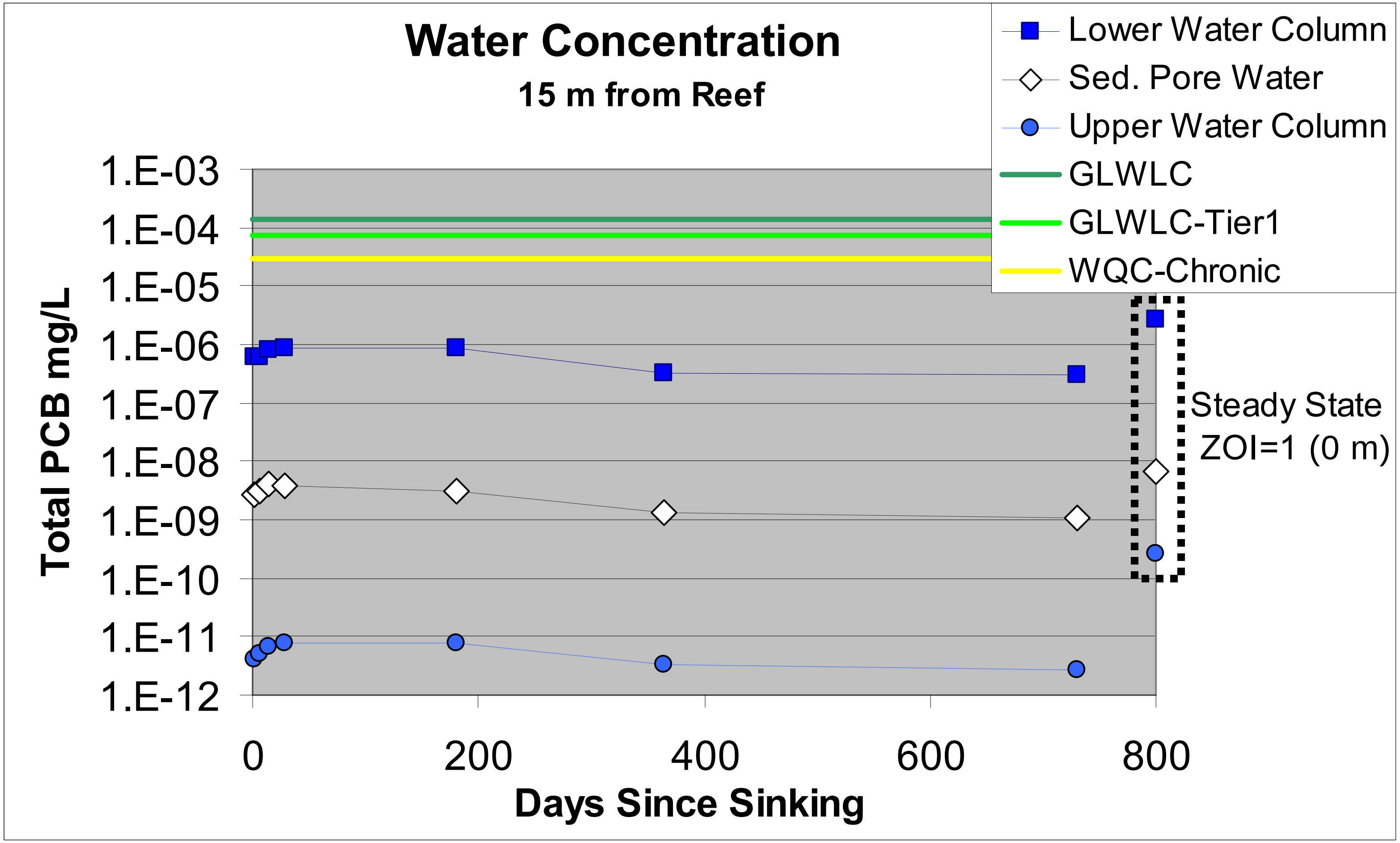


Fig. 31. Time series of Total PCB concentrations predicted by the TDM for the upper water column, lower water column, and sediment pore water within 15 m of the ship for the first two years following sinking and the steady state concentrations predicted by PRAM with a ZOI=1. The water quality benchmarks are also shown.

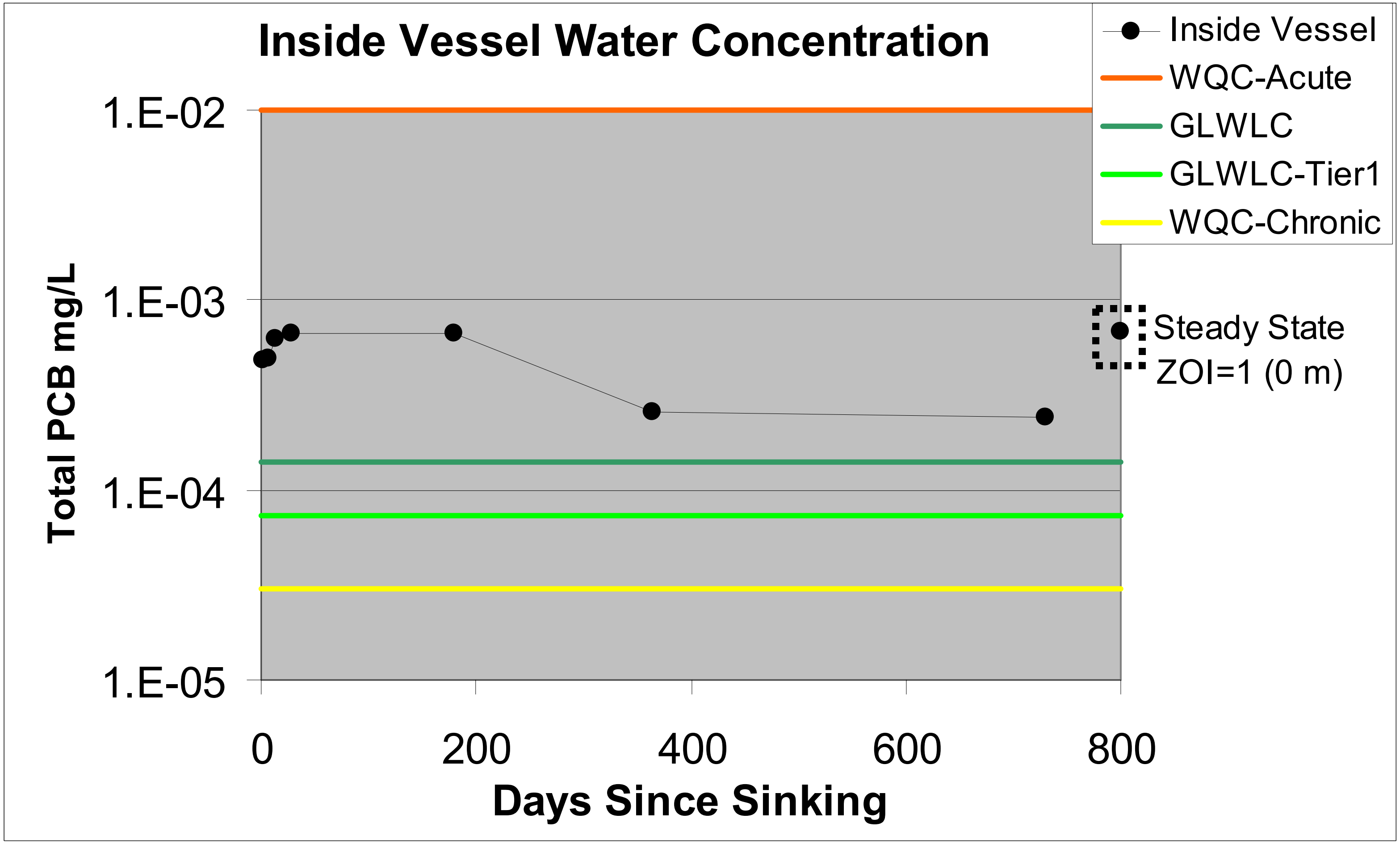


Fig. 32. Time series of Total PCB concentrations predicted by the TDM for the interior vessel water for the first two years following sinking and the steady state concentrations predicted by PRAM with a ZOI=1. The water quality benchmarks are also shown.

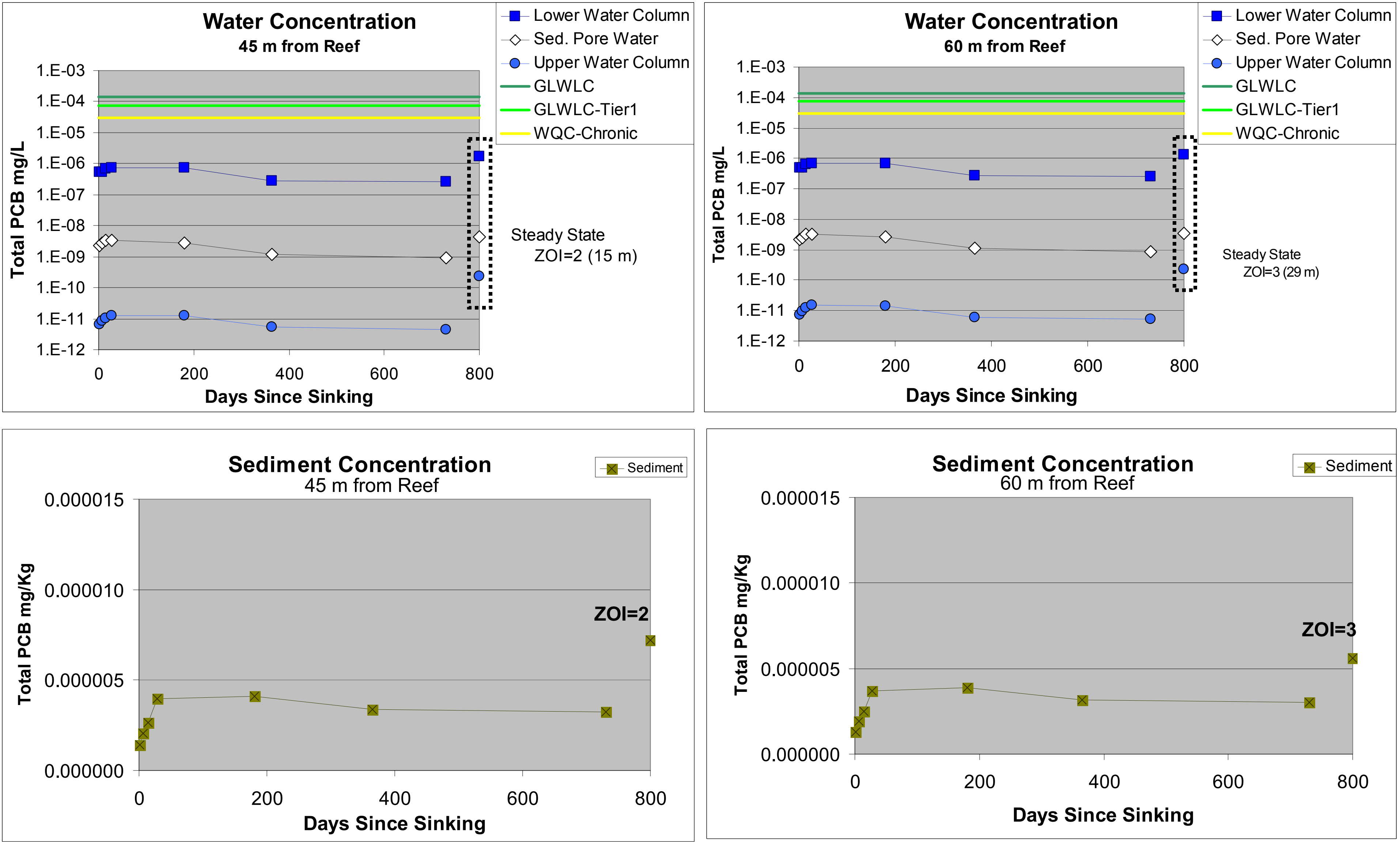


Fig. 33. Water and sediment concentrations predicted for 45 m and 60 m from the reef and the steady state water and sediment concentrations predicted by PRAM for ZOI=2 and ZOI=3. The water quality benchmarks are also shown.

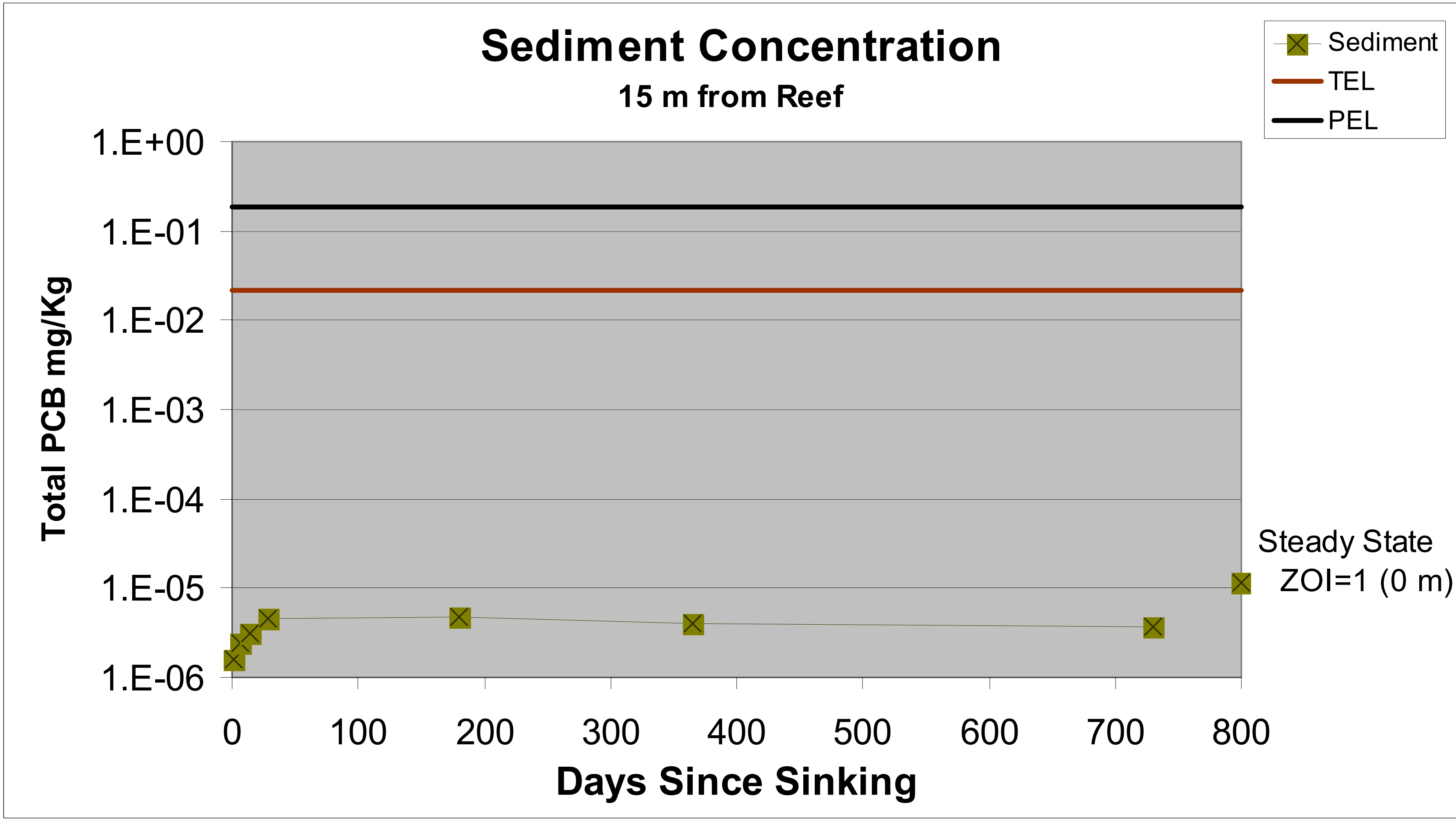


Fig. 34. Time series of Total PCB concentrations predicted by the TDM for sediment within 15 m of the ship for the first two years following sinking and the steady state concentrations predicted by PRAM with a ZOI=1. The sediment quality benchmarks are also shown.

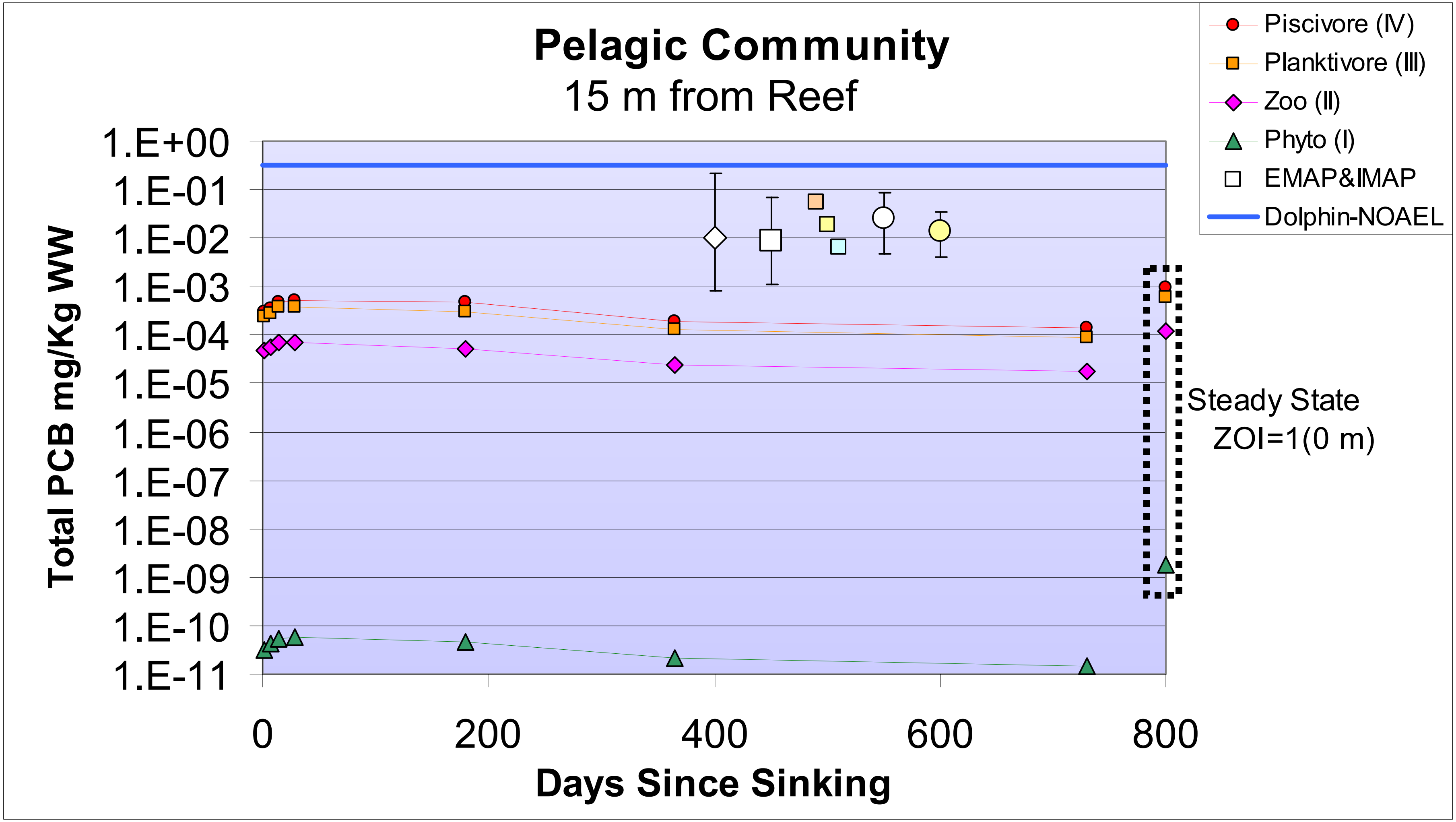


Fig. 35. Time series of Total PCB concentrations predicted by PRAM for the Pelagic Community within 15 m of the reef for the first two years following sinking and the steady state concentrations with a ZOI=1. EMAP data for Atlantic croaker (white symbols) and spot (yellow symbols) are average (min and max) for all data from the Louisianan Province (diamond), Gulf Coast of Florida (large square), and Carolinian Province (circles). IMAP data are for three samples of sea trout, spot, and sea pig collected offshore of Pensacola (small squares). The dietary NOAEL for dolphin consumption of prey is also shown.

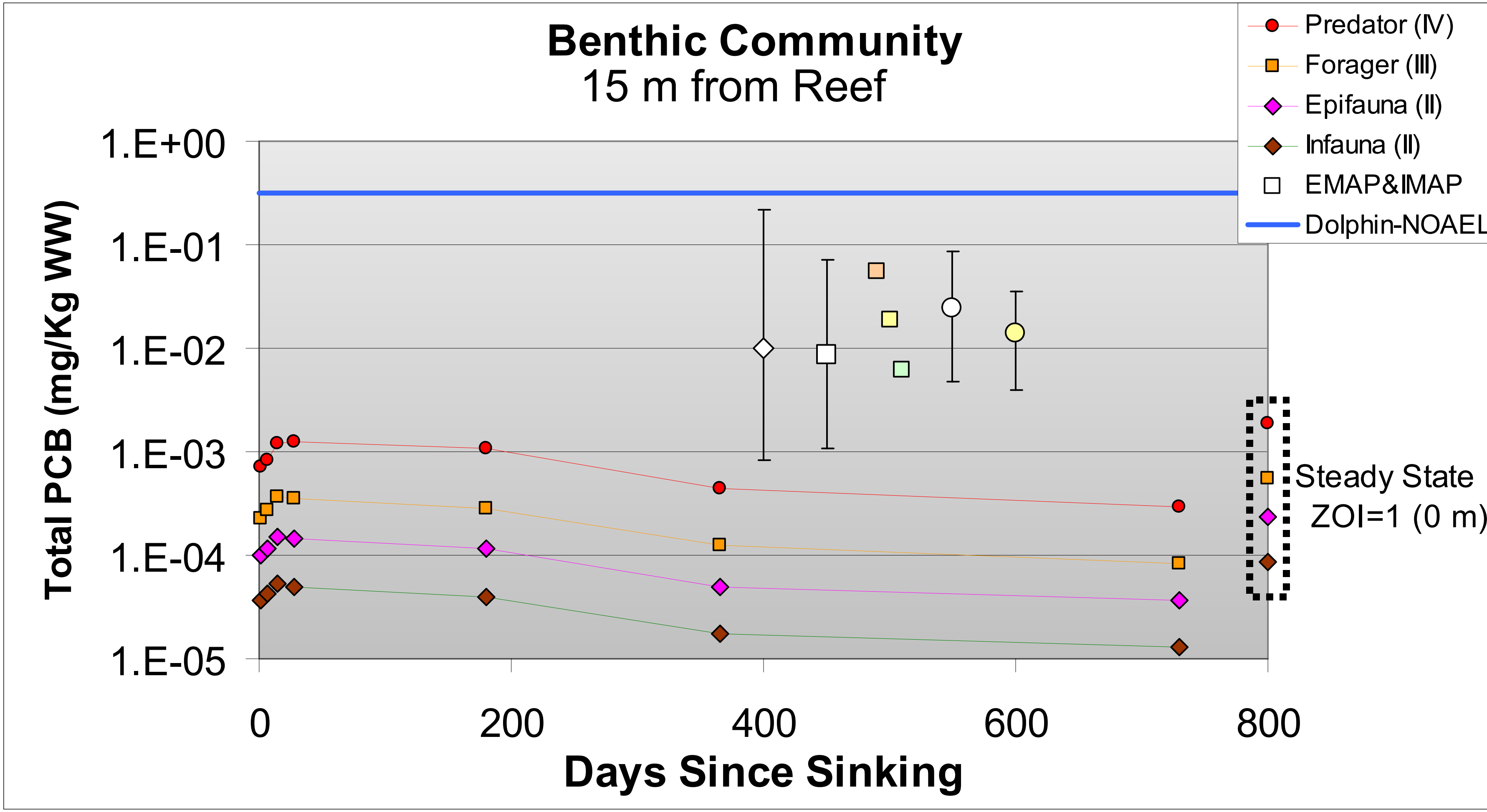


Fig. 36. Time series of Total PCB concentrations predicted by PRAM for the Benthic Community within 15 m of the reef for the first two years following sinking and the steady state concentrations with a ZOI=1. EMAP data for Atlantic croaker (white symbols) and spot (yellow symbols) are average (min and max) for all data from the Louisianan Province (diamond), Gulf Coast of Florida (large square), and Carolinian Province (circles). IMAP data are for three samples of sea trout, spot, and sea pig collected offshore of Pensacola (small squares). The dietary NOAEL for dolphin consumption of prey is also shown.

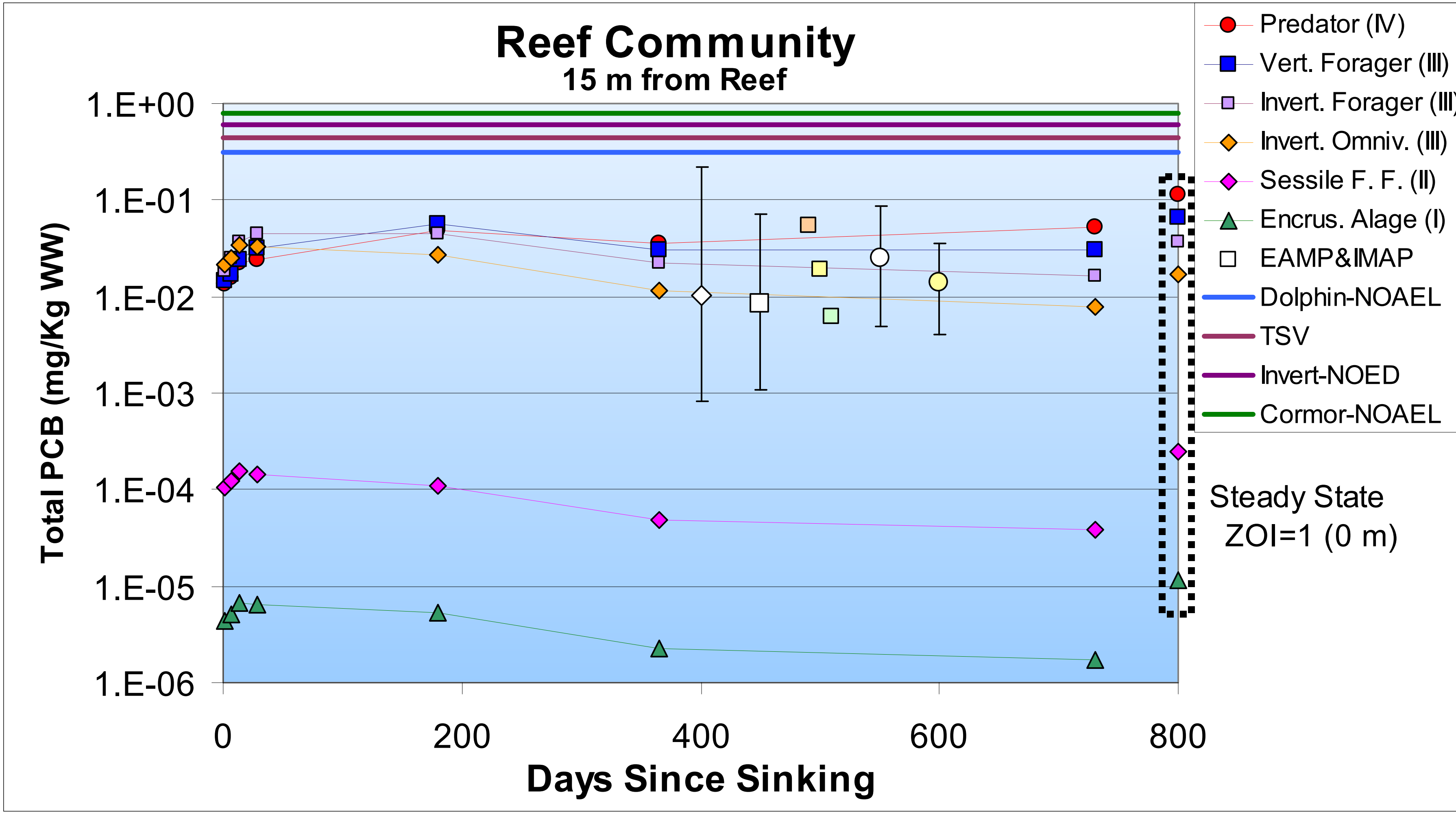


Fig. 37. Time series of Total PCB concentrations predicted by PRAM for the Reef Community within 15 m of the reef for the first two years following sinking and the steady state concentrations with a ZOI=1. EMAP data for Atlantic croaker (white symbols) and spot (yellow symbols) are average (min and max) for all data from the Louisianan Province (diamond), Gulf Coast of Florida (large square), and Carolinian Province (circles). IMAP data are for three samples of sea trout, spot, and sea pig collected offshore of Pensacola (small squares). Some of the most conservative ecorisk benchmarks are also shown.

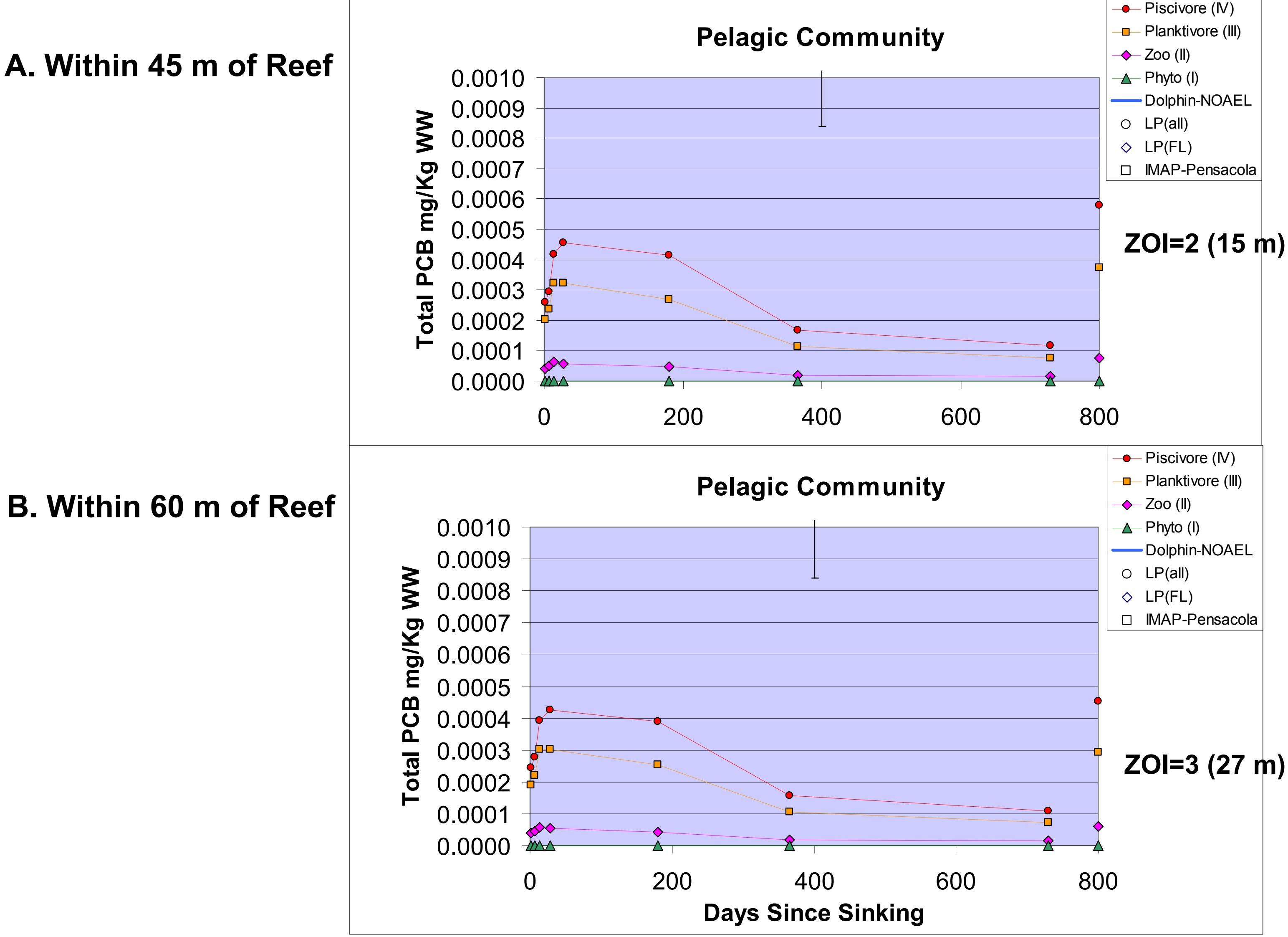
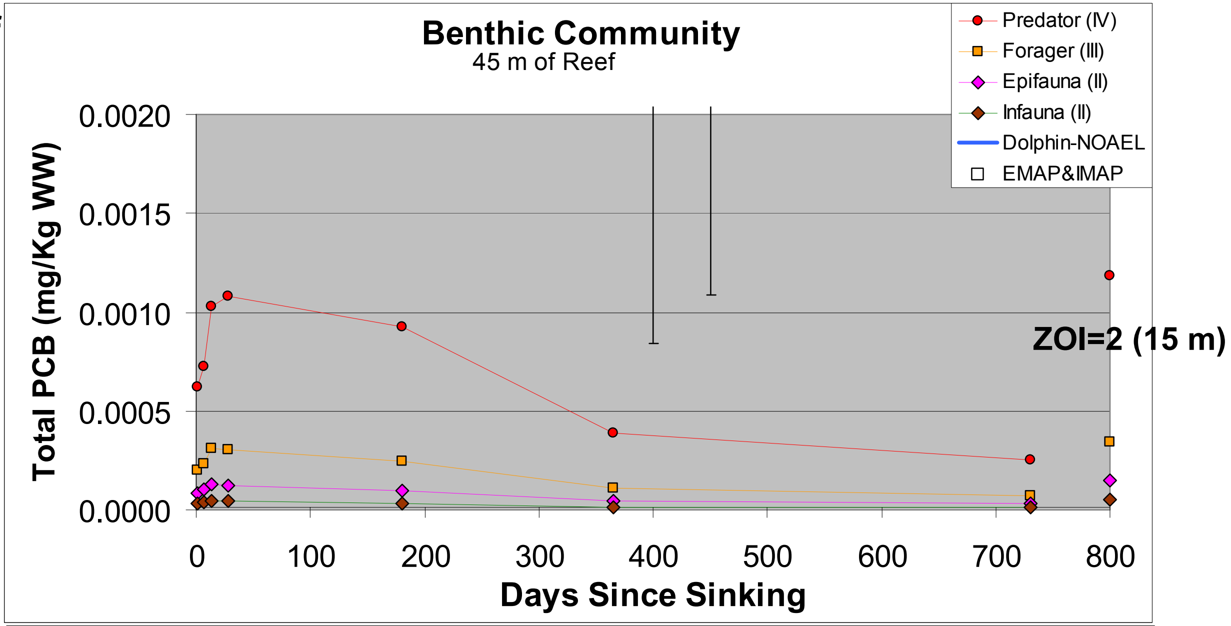


Fig. 38. Tissue residues for the pelagic community predicted by PRAM based on TDM output for 45 m and 60 m from the ship and steady state concentrations predicted by PRAM with a ZOI=2 and ZOI=3. Error bar visible is min range for EMAP LP.

A. 45 m from Reef



B. 60 m from Reef

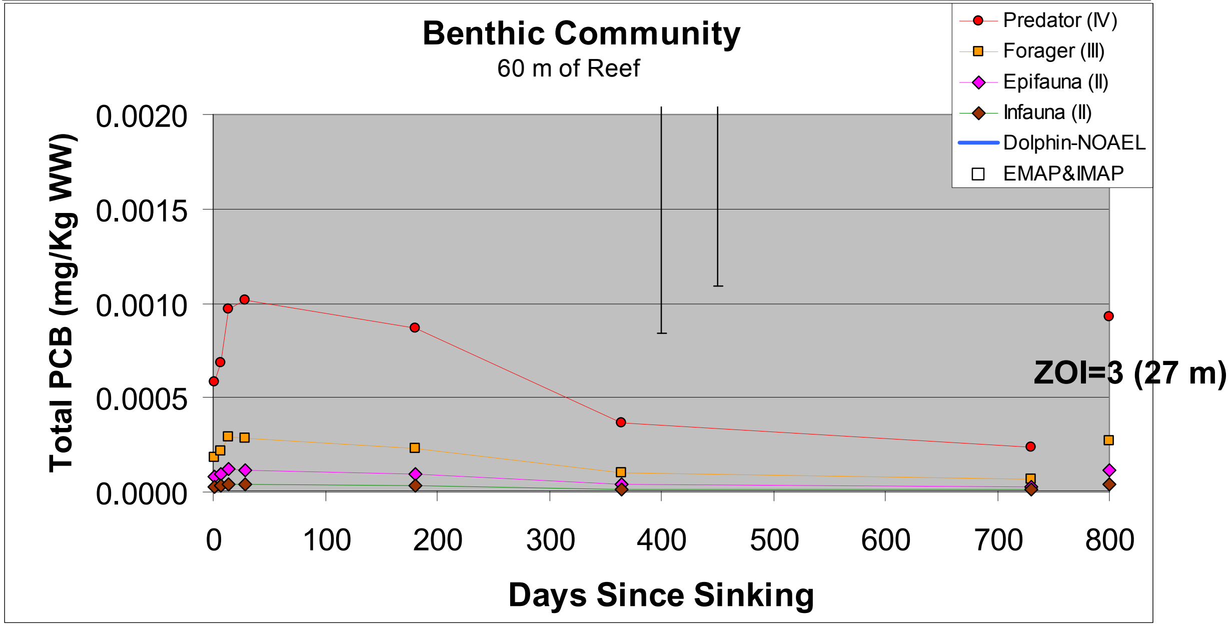


Fig. 39. Tissue residues predicted by PRAM for the benthic community based on TDM output for 45 m and 60 m from the ship and with a ZOI=2 and ZOI=3. Error bars visible are min range for EMAP-LP and EMAP-FLA data, respectively.

A. 45 m from Reef

B. 60 m from Reef

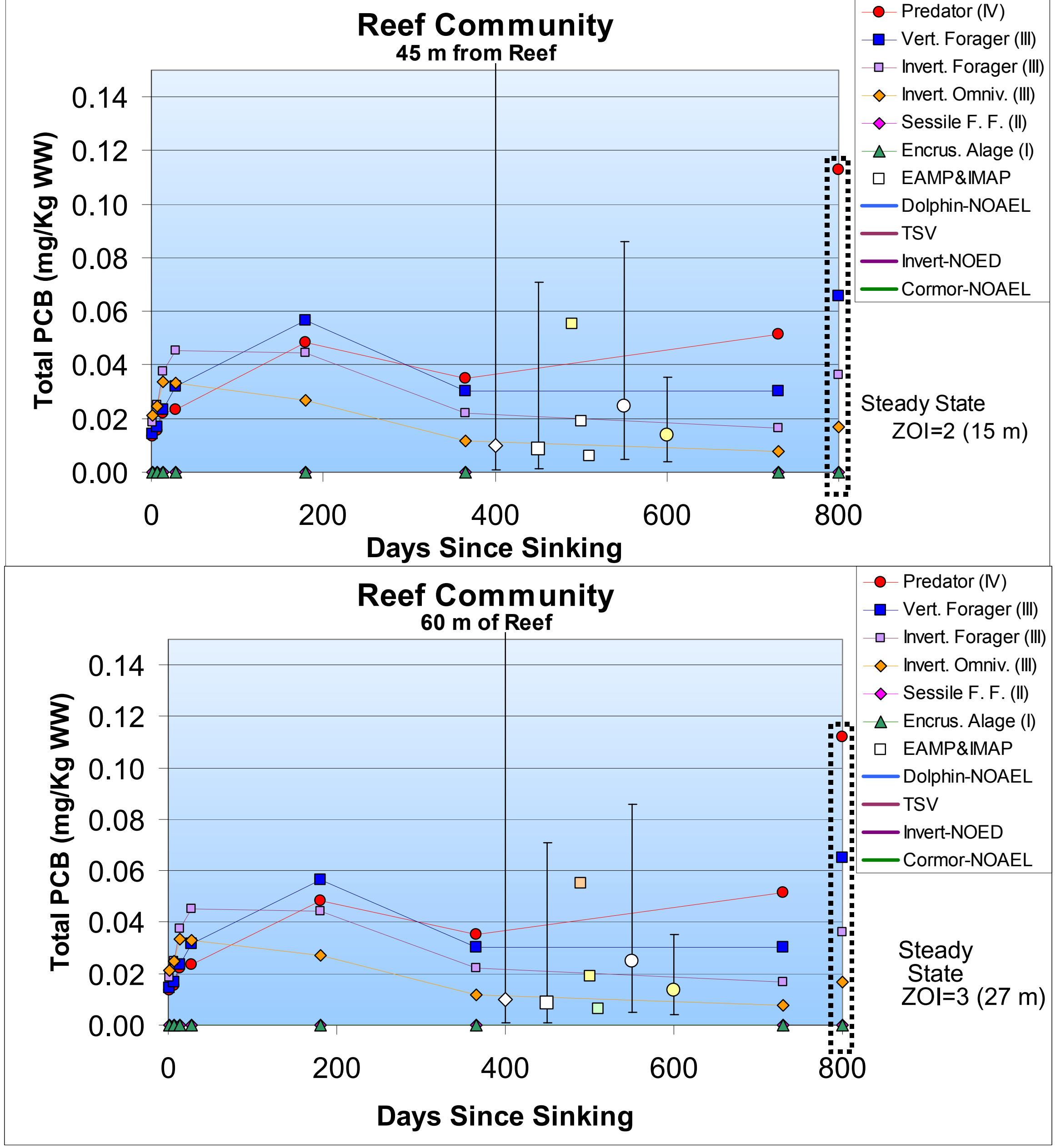


Fig. 40. Tissue residues for reef community predicted by PRAM based on TDM output for 45 m and 60 m from the ship and with a ZOI=2 and ZOI=3. EMAP data for Atlantic croaker (white symbols) and spot (yellow symbols) are average (min and max) for all data from the Louisianan Province (diamond), Gulf Coast of Florida (large square), and Carolinian Province (circles). IMAP data are for three samples of sea trout, spot, and sea pig from Pensacola (small squares).

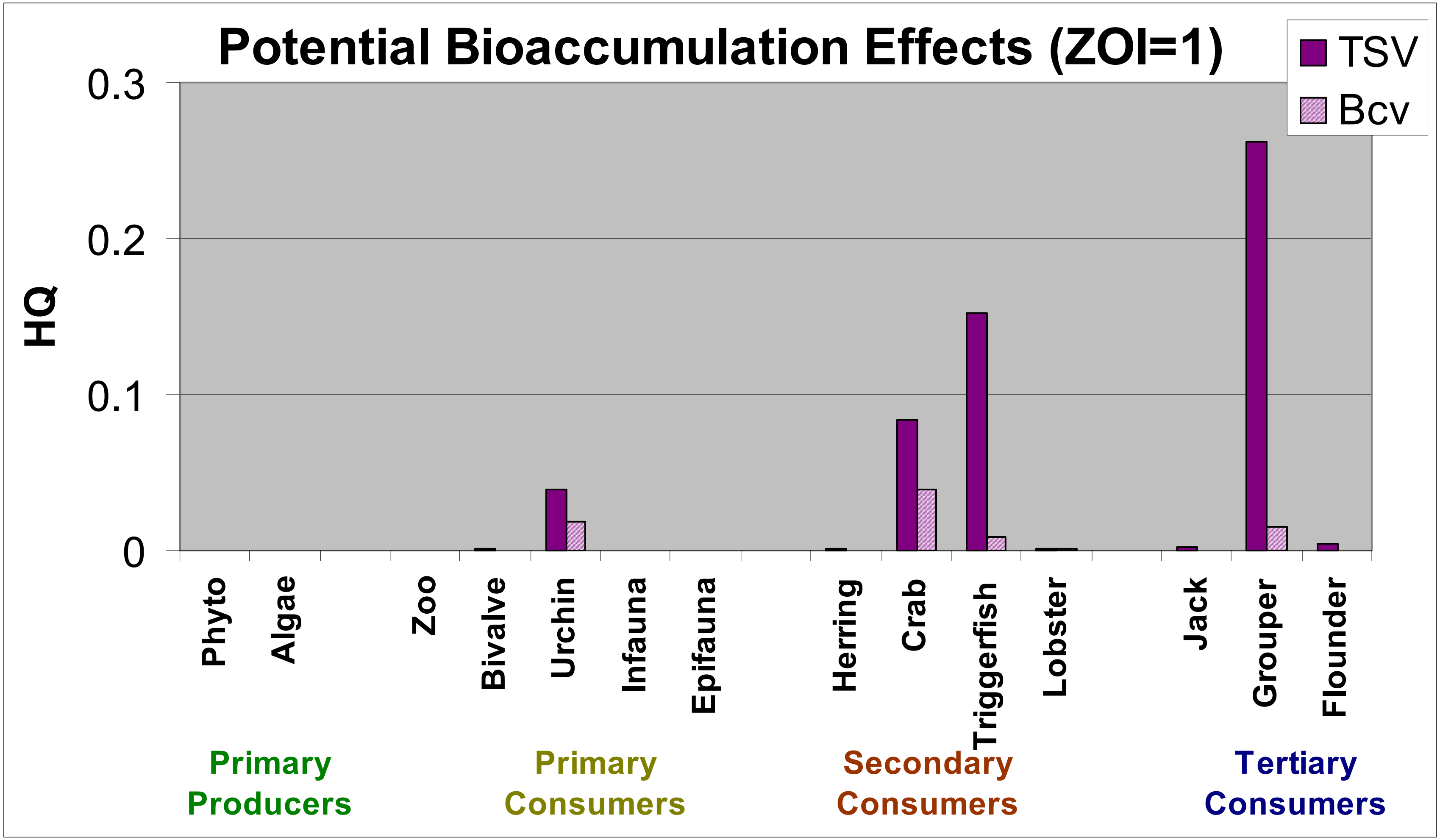


Fig. 41. Potential effects from bioaccumulation suggested by the HQs of tissue residues predicted by PRAM with a ZOI=1 for the tissue screening value (TSV) and bioaccumulation critical value (Bcv).

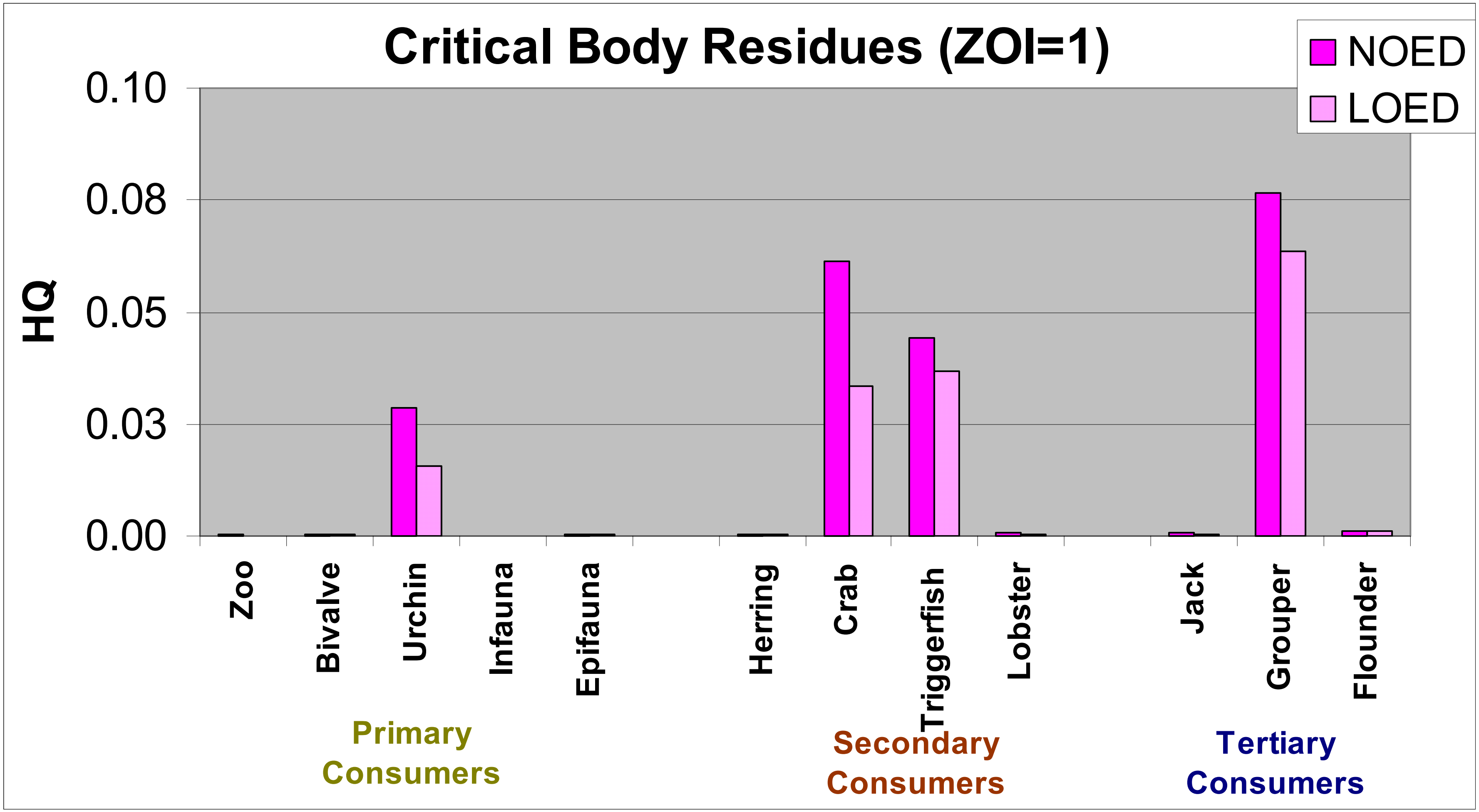


Fig. 42. Potential effects from critical body residues for invertebrates and fish suggested by the HQs of tissue residues predicted by PRAM with a ZOI=1 for the no observed effects dose (NOED) and the lowest observed effects dose (LOED).

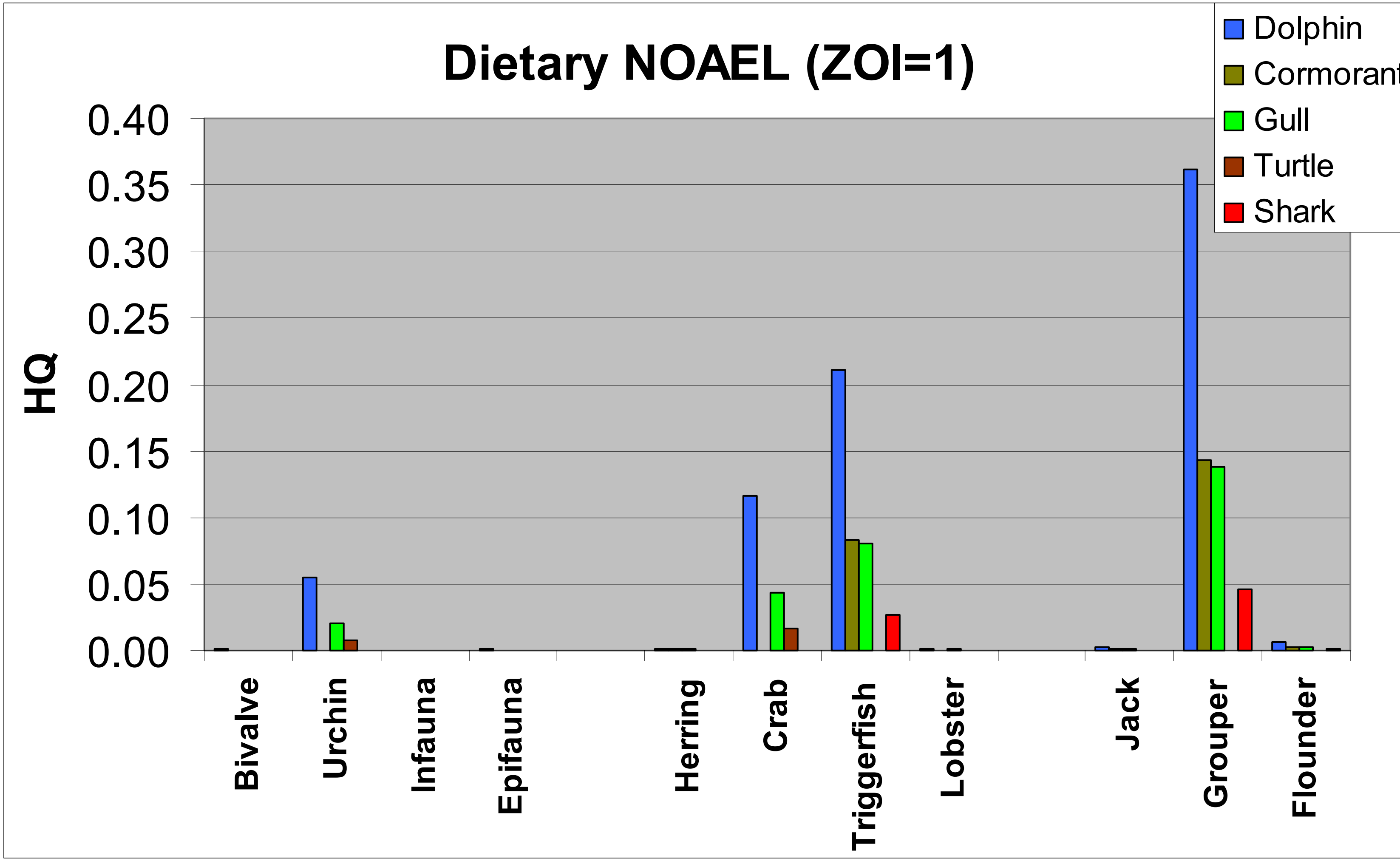


Fig. 43. Potential effects from dietary exposure to reef consumers suggested by the HQs of tissue residues predicted by PRAM with a ZOI=1 for the dietary no observed adverse effect levels (NOAEL).

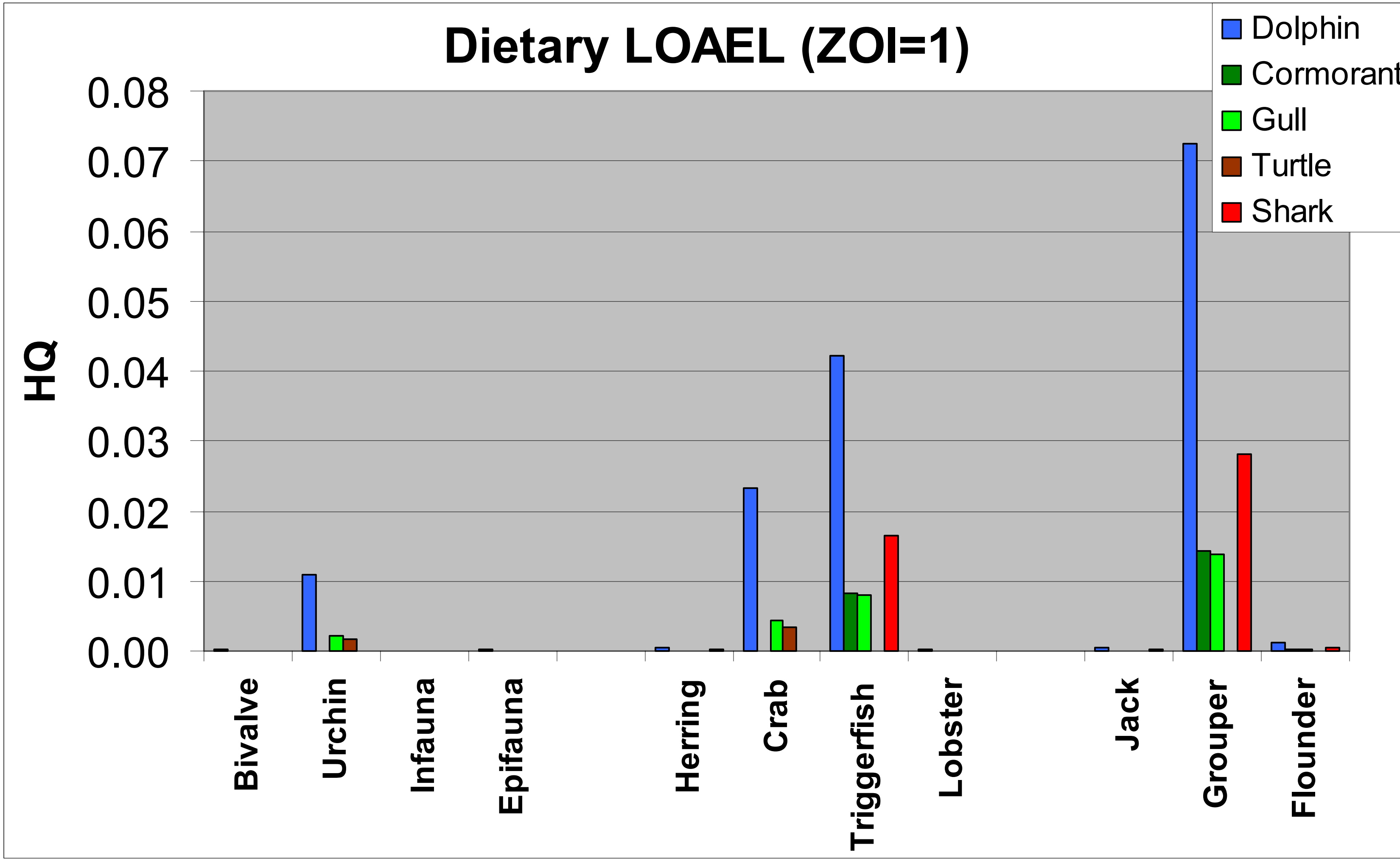


Fig. 44. Potential effects from dietary exposure to reef consumers suggested by the HQs of tissue residues predicted by PRAM with a ZOI=1 for the dietary lowest observed adverse effect levels (LOAEL).

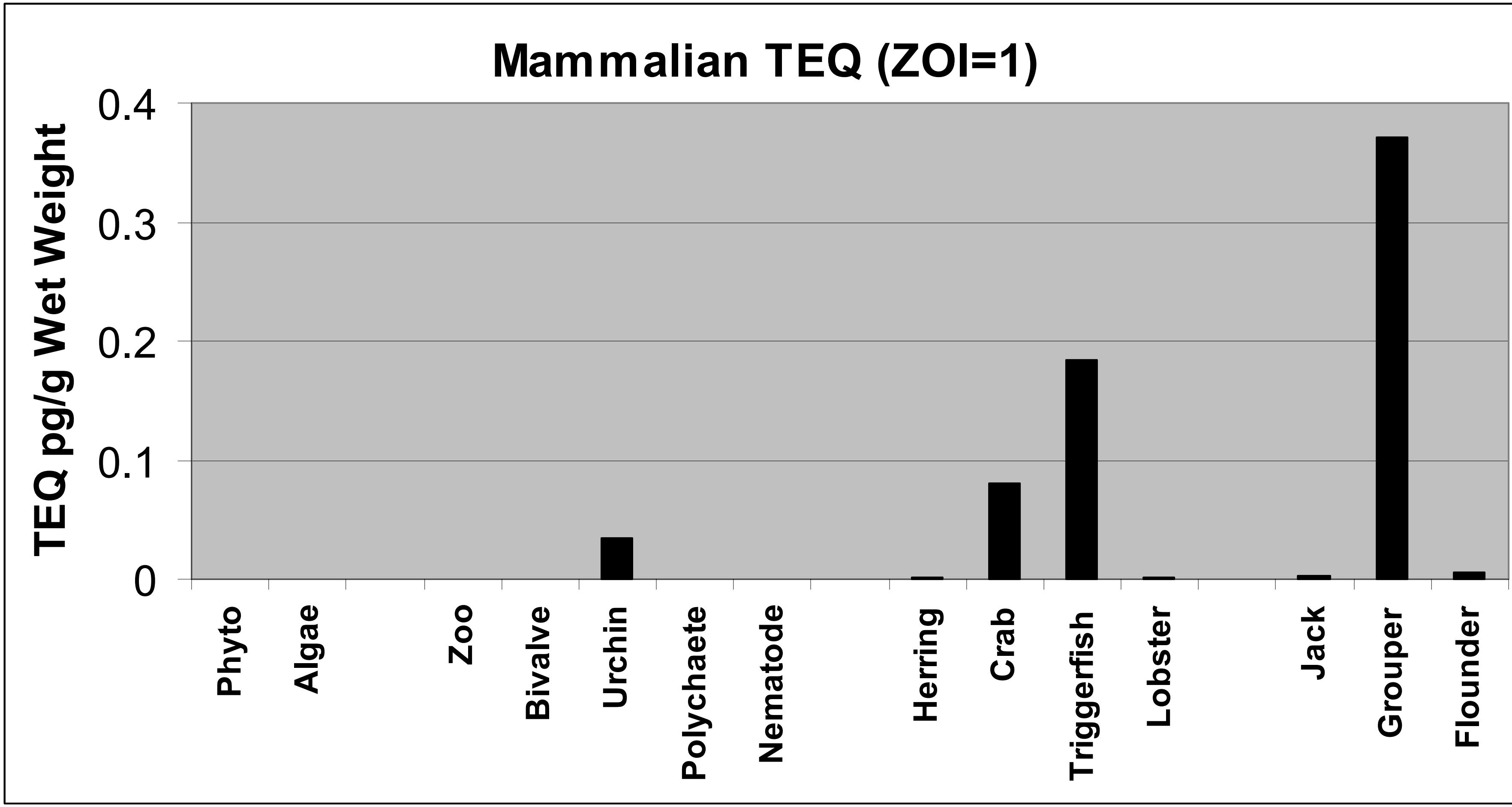


Fig. 45. Dioxin-like mammalian TEQs for food chain residues predicted by PRAM with a ZOI=1.

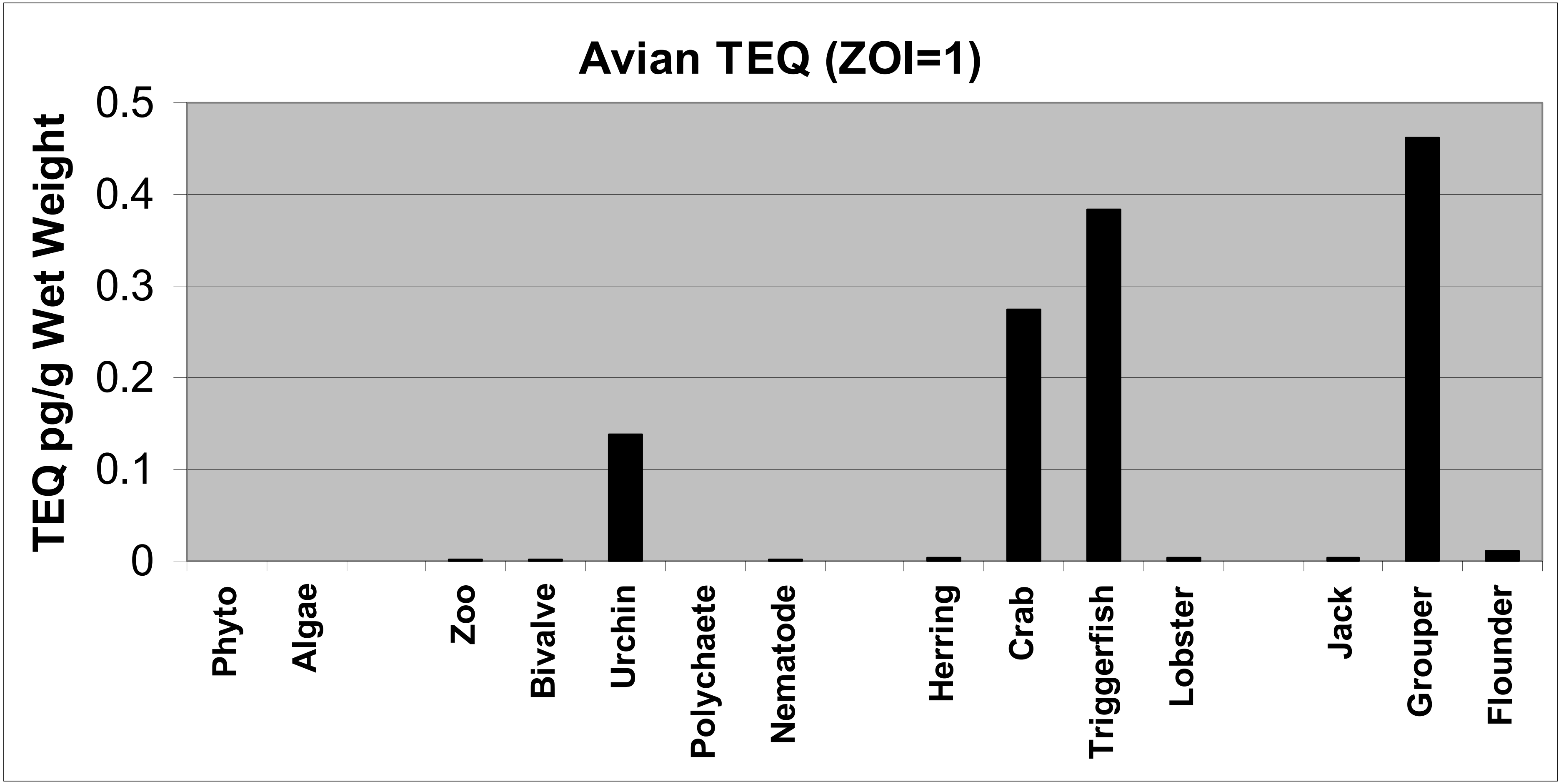


Fig. 46. Dioxin-like avian TEQs for food chain residues predicted by PRAM with a ZOI=1.

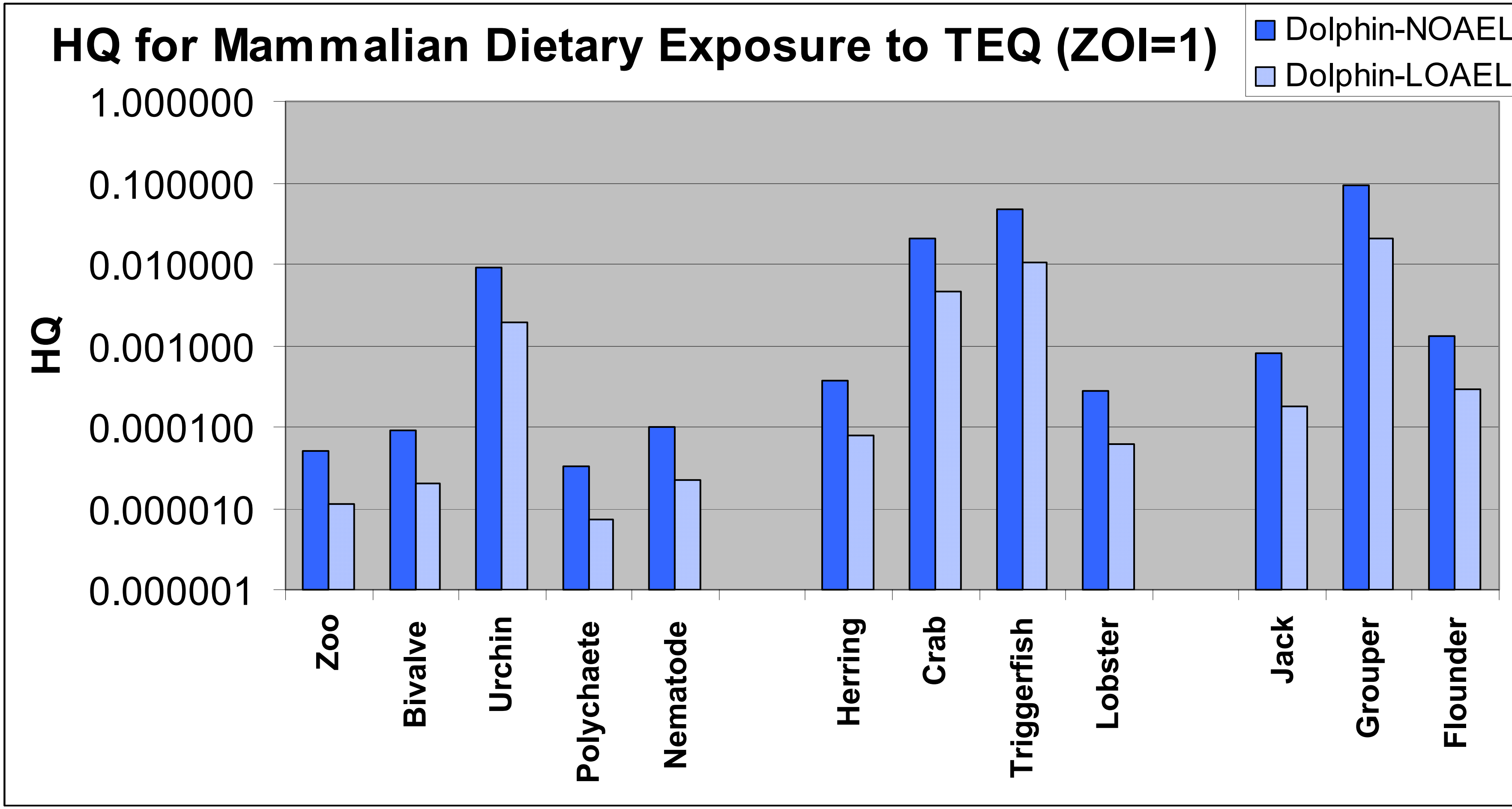


Fig. 47. Potential effects from dietary exposure of TEQ to dolphins suggested by the HQs of tissue residues predicted by PRAM with a ZOI=1.

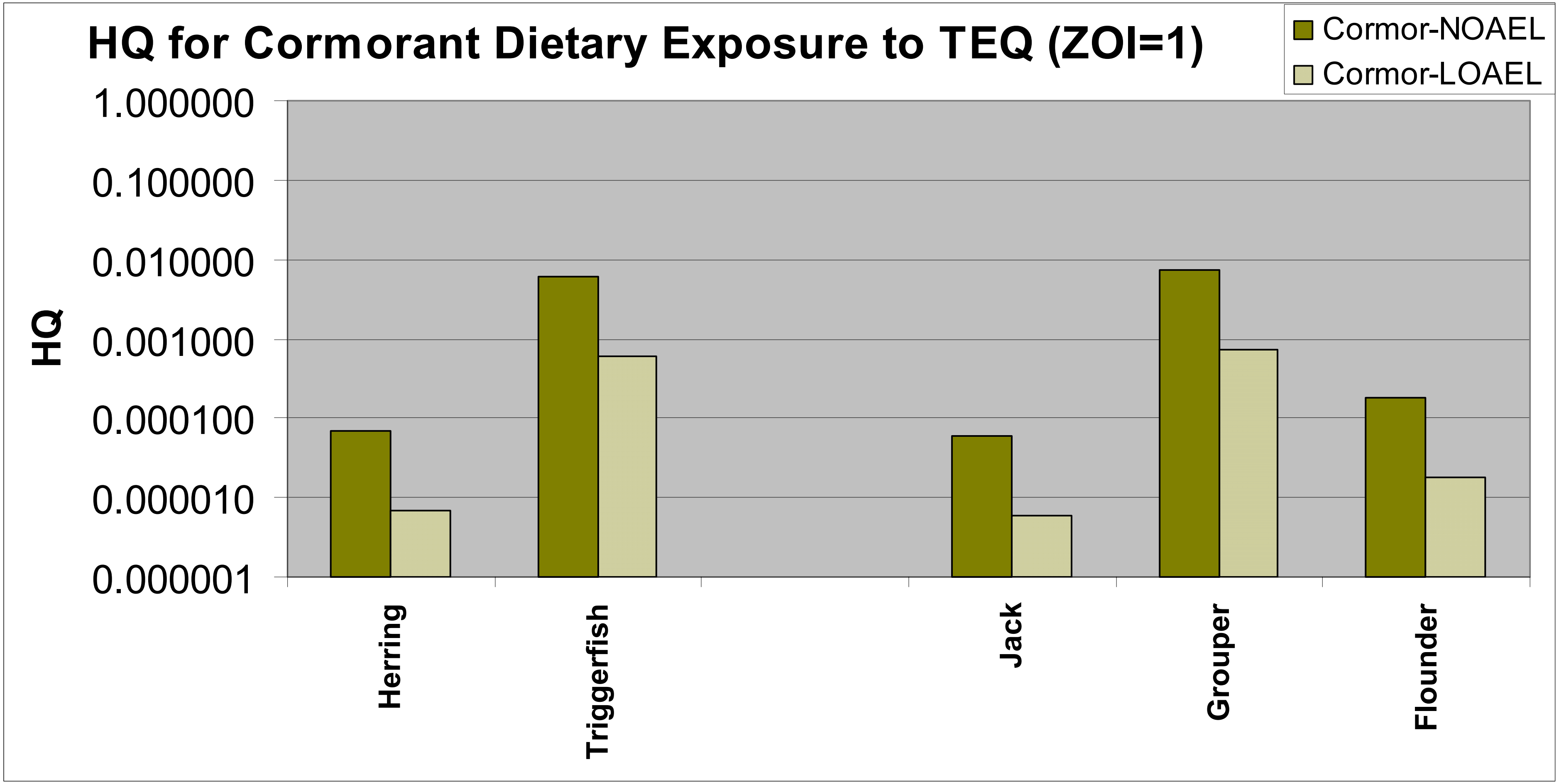


Fig. 48. Potential effects from dietary exposure of TEQ to cormorants suggested by the HQs of tissue residues predicted by PRAM with a ZOI=1.

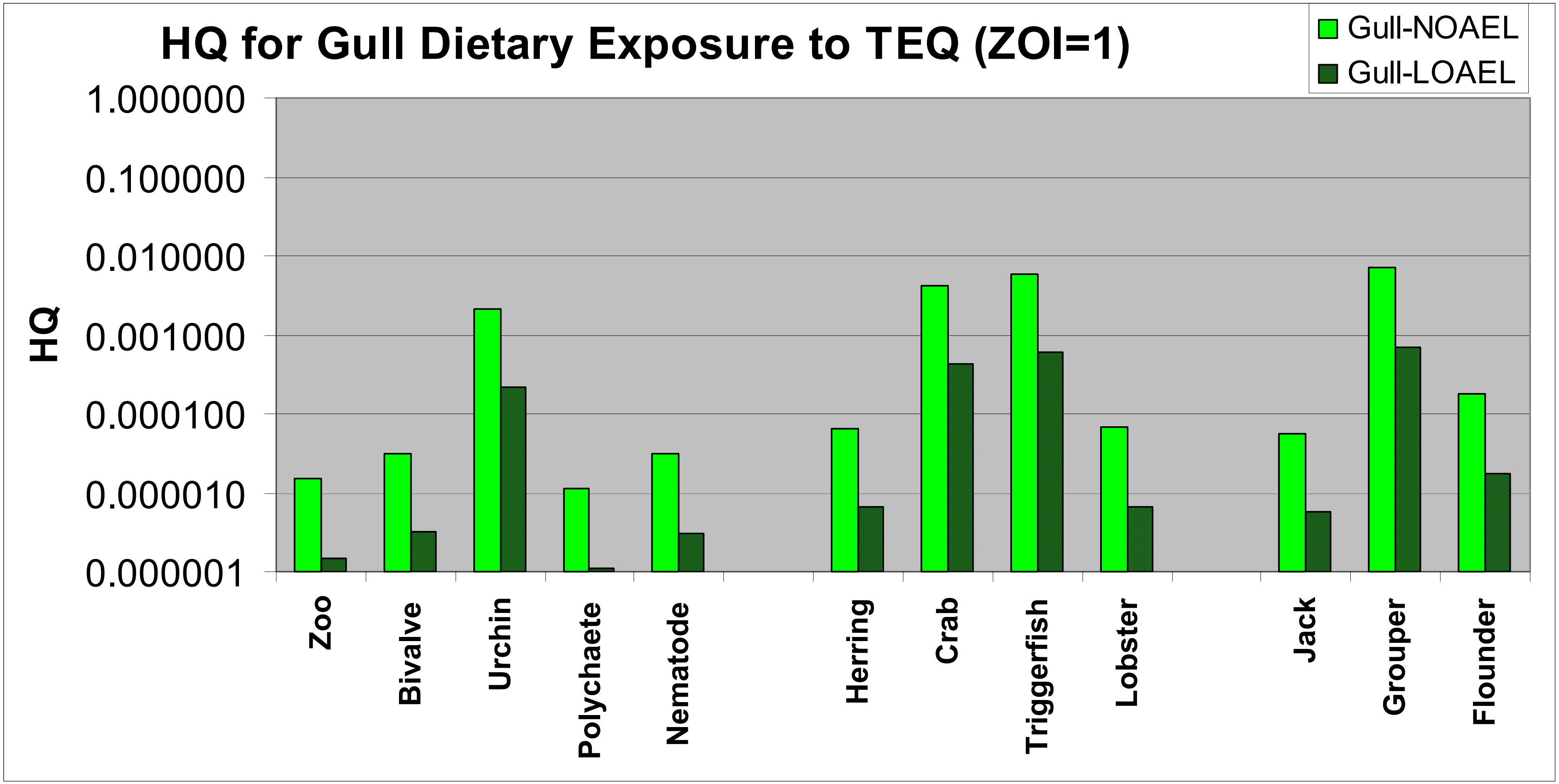


Fig. 49. Potential effects from dietary exposure of TEQ to herring gulls suggested by the HQs of tissue residues predicted by PRAM with a ZOI=1.

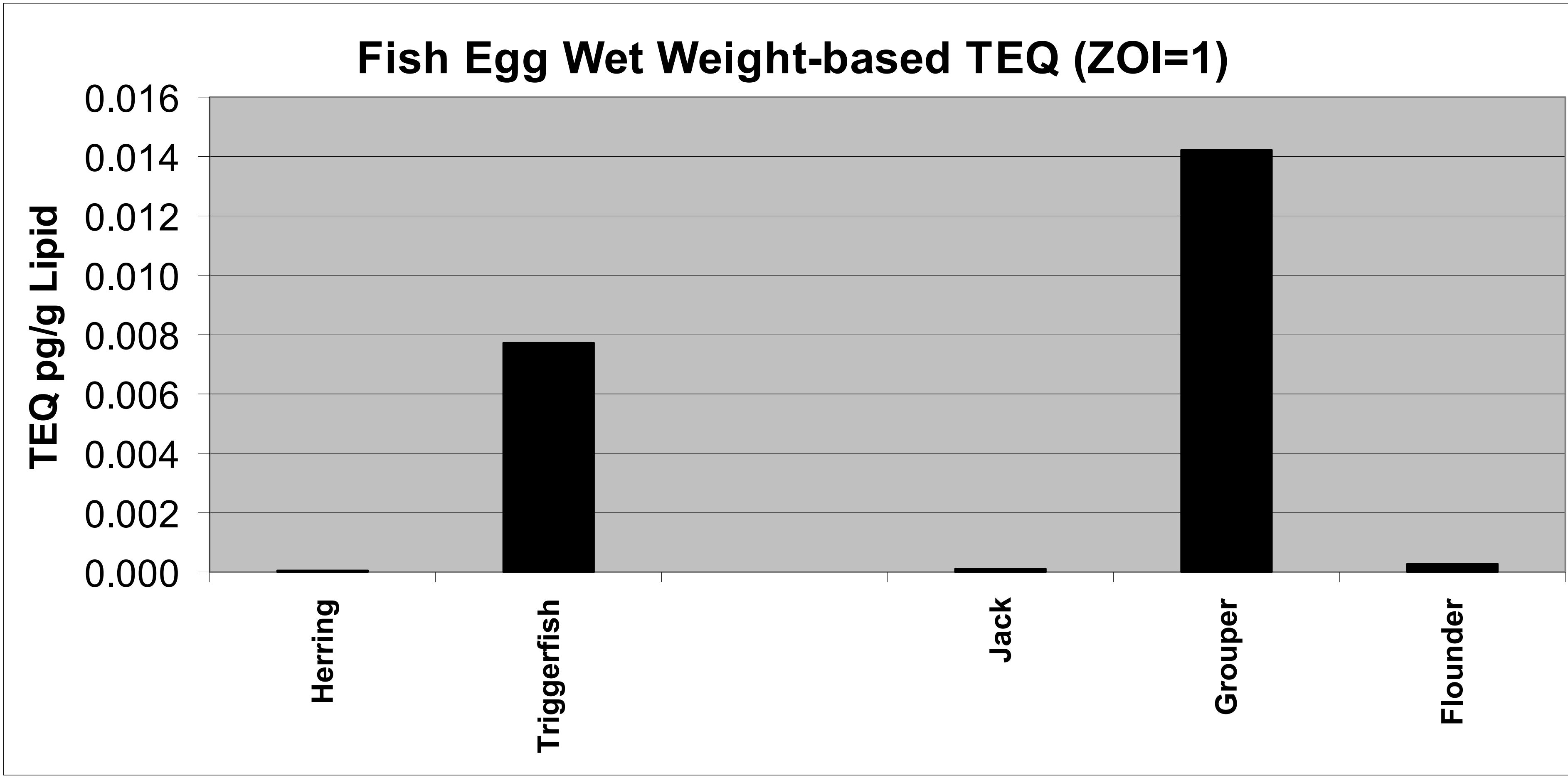


Fig. 50. Dioxin-like TEQs in fish eggs (wet weight) based on food chain residues predicted by PRAM with a ZOI=1.

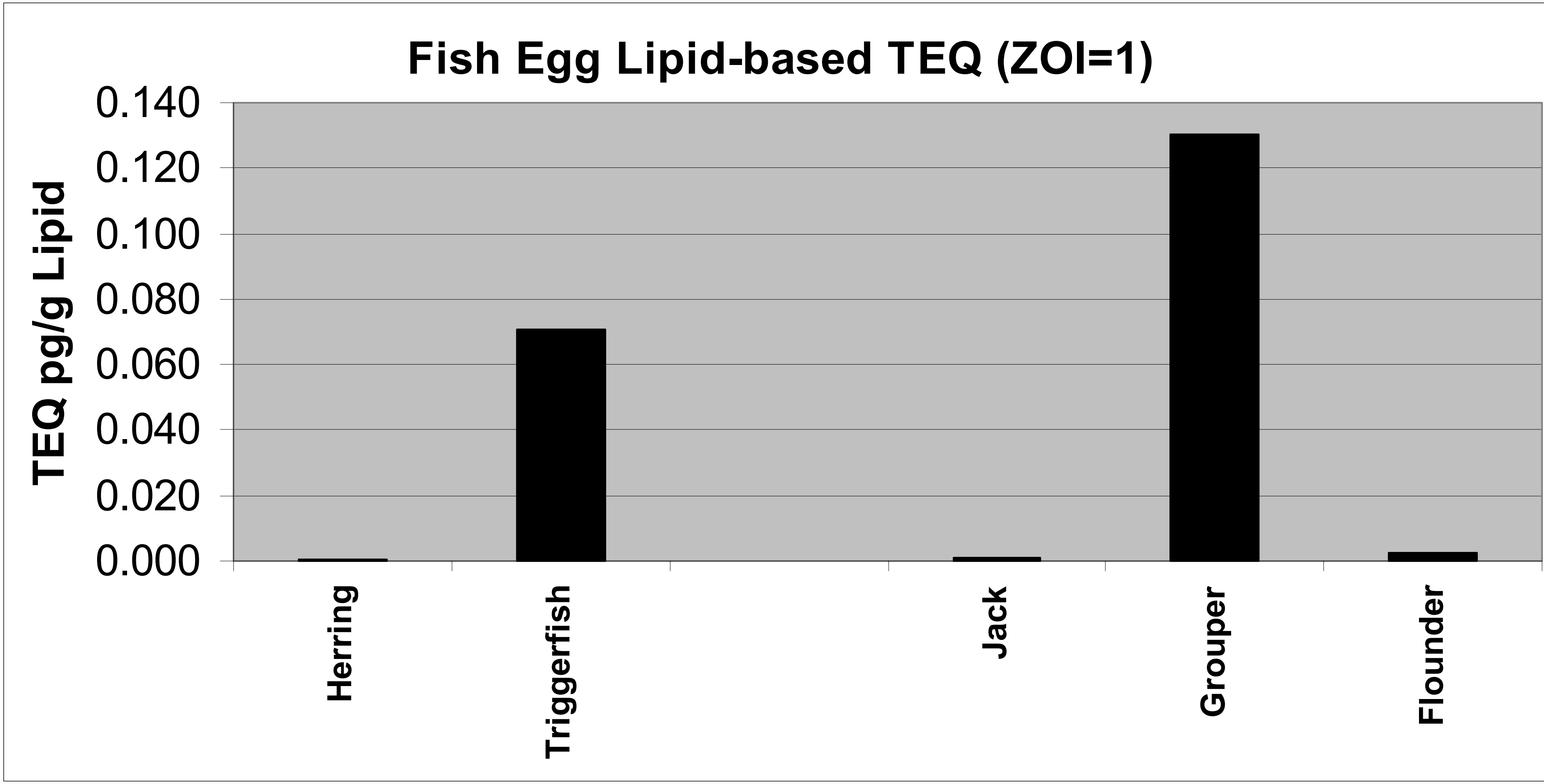


Fig. 51. Dioxin-like TEQs in fish eggs (lipid weight) based on food chain residues predicted by PRAM with a ZOI=1.

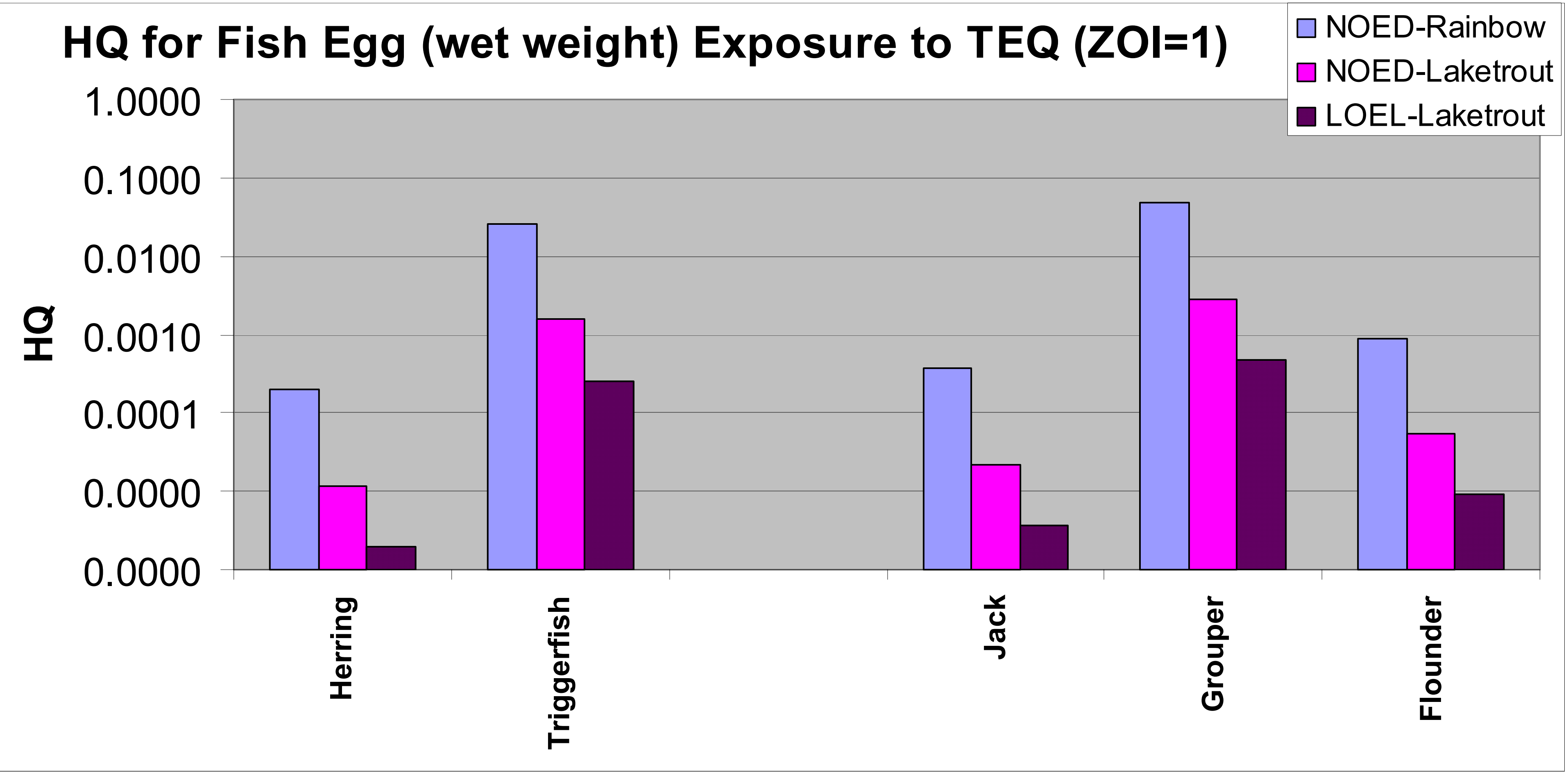


Fig. 52. Potential effects from TEQ exposure of fish eggs (wet weight) suggested by the HQs of fish egg tissue residues based on predictions by PRAM with a ZOI=1.

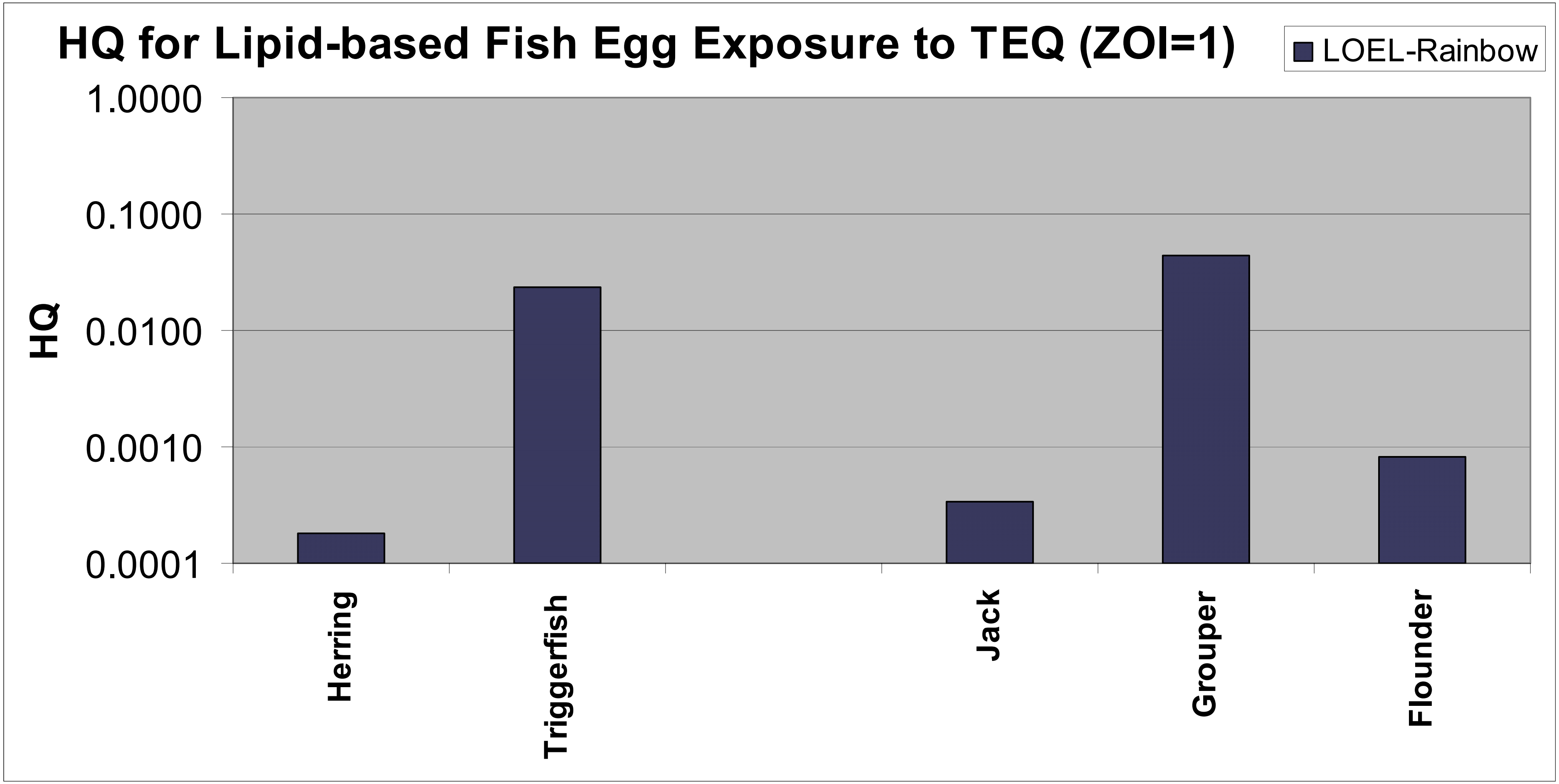


Fig. 53. Potential effects from TEQ exposure of fish eggs (lipid weight) suggested by the HQs of fish egg tissue residues based on predictions by PRAM with a ZOI=1.

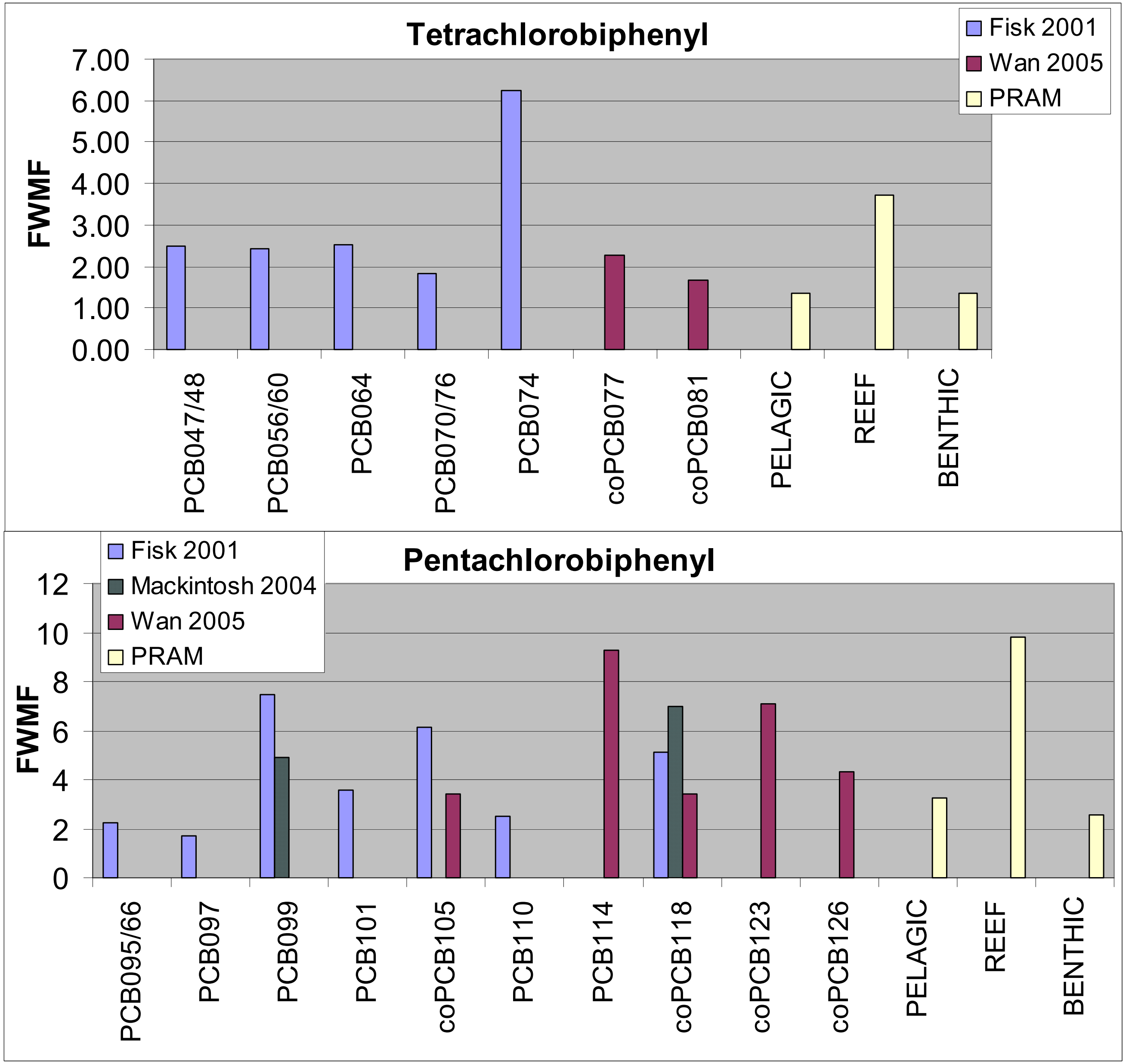


Fig. 54. The food web magnification factors (FWMF) for coplanar (co) and non-coplanar PCBs reported in the literature and simulated by PRAM for tetra- and pentachlorobiphenyls.

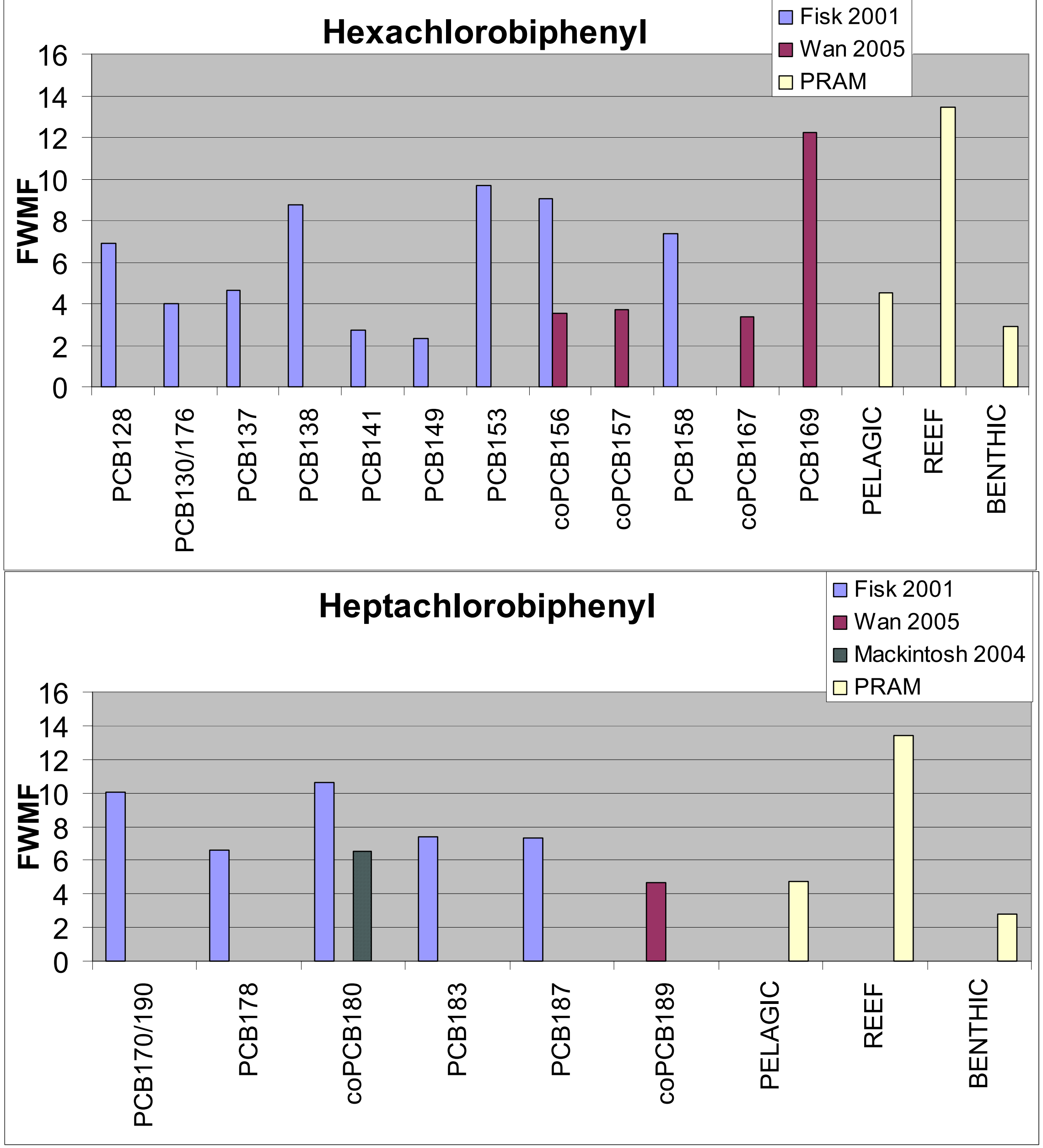
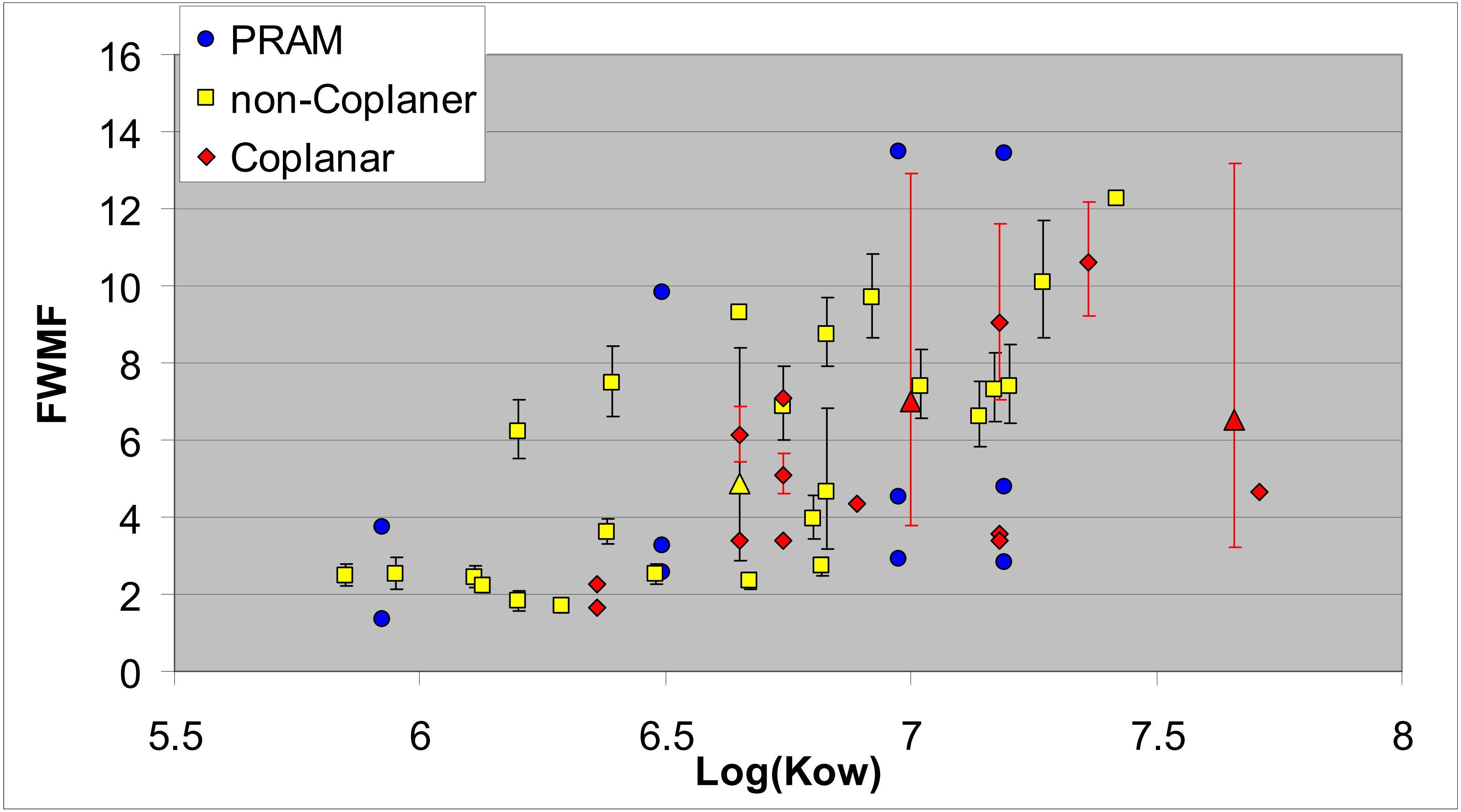
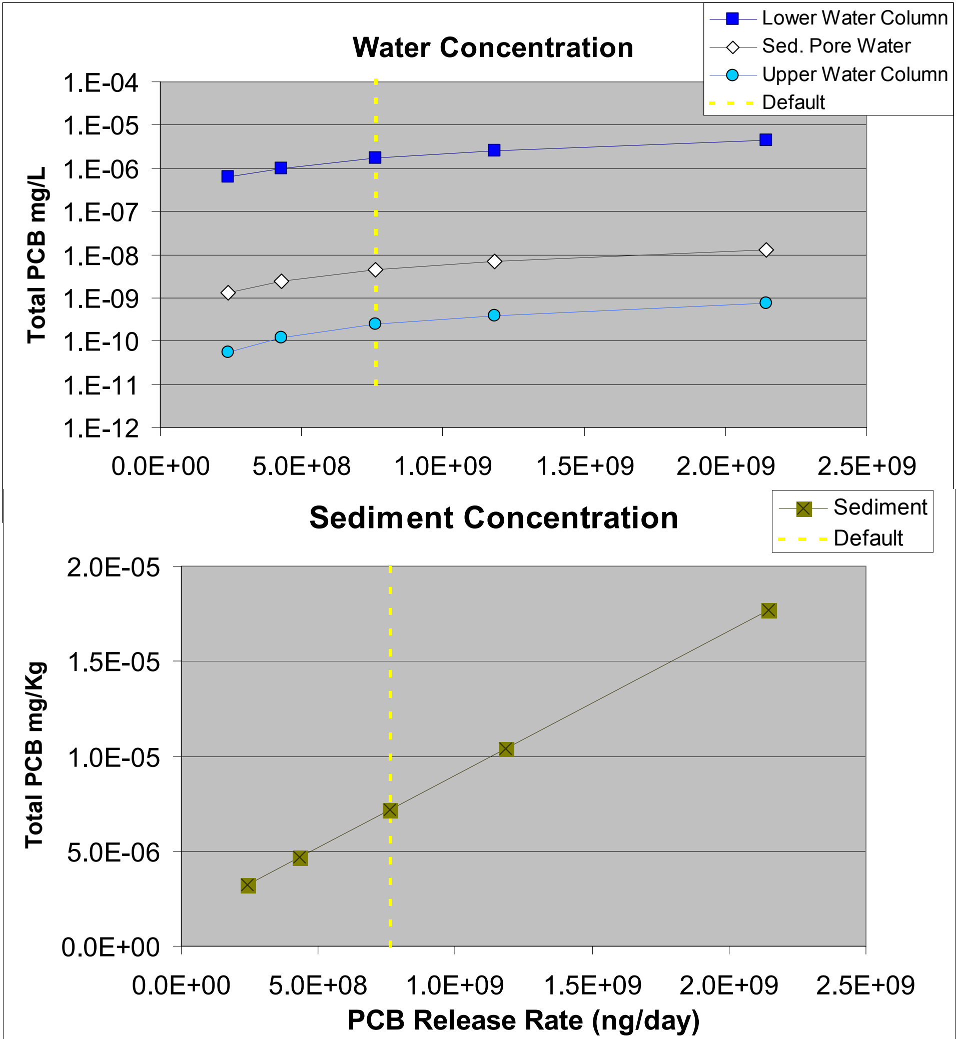


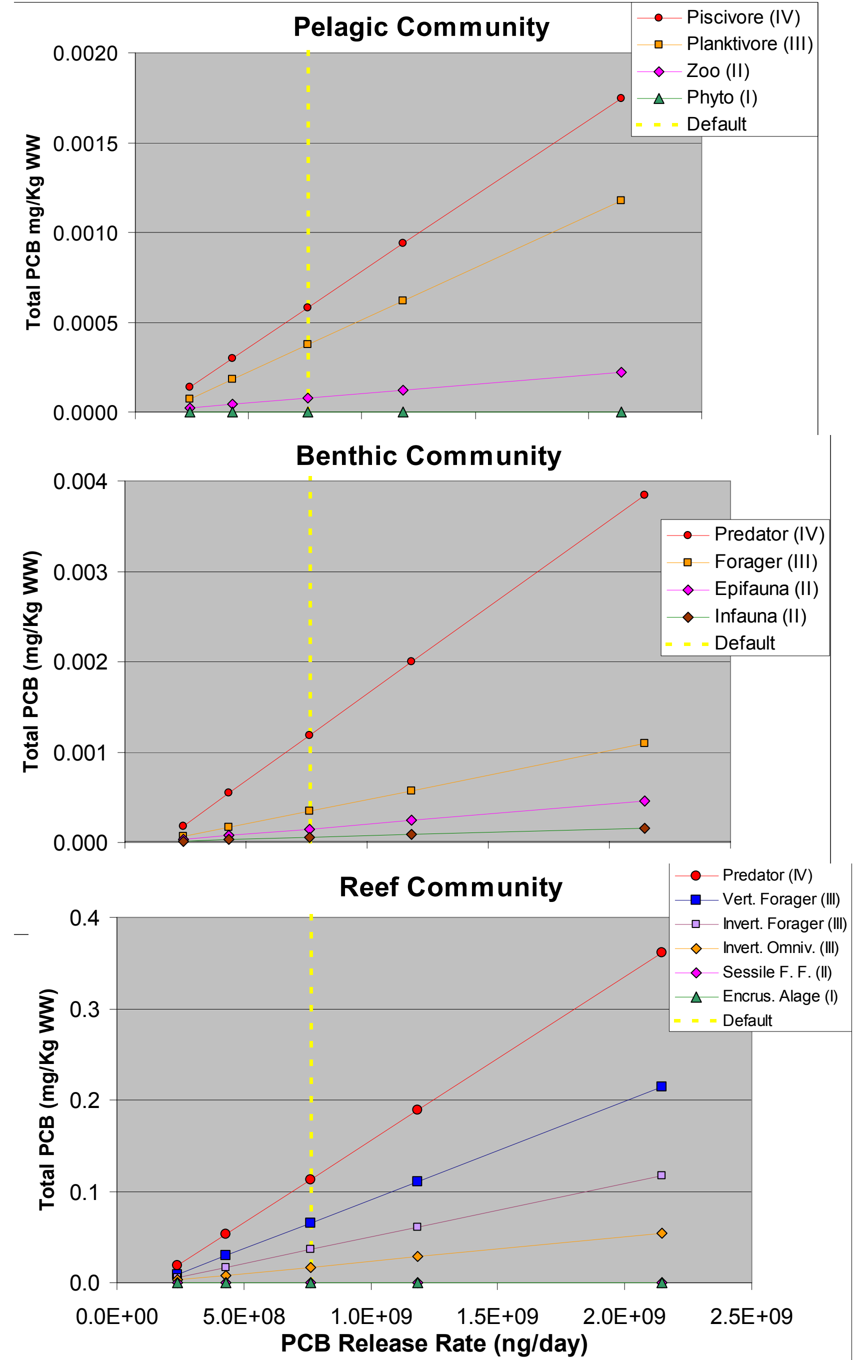
Fig. 55. The food web magnification factors (FWMF) for coplanar (co) and non-coplanar PCBs reported in the literature and simulated by PRAM for hexa- and heptachlorobiphenyls.



error bars on Mackintosh 2004 (triangles) are 95th% CL
error bars on Fisk 2001 are +/- 1 Std error

Fig. 56. The range of food web magnification factors (FWMF) for coplanar (red) and non-coplanar (yellow) PCBs reported in the literature and simulated by PRAM (blue) for tetra-, penta-, hexa-, and heptachlorobiphenyls. Literature values are from Fisk et al. 2001, Mackintosh et al. 2004, and Wan et al. 2005.





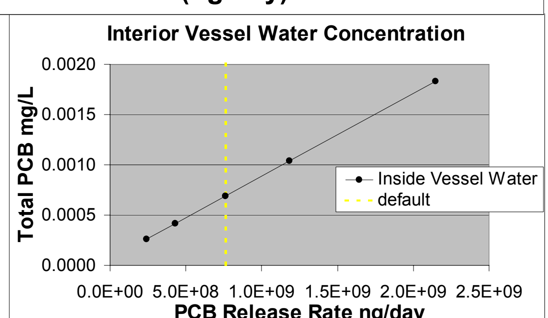
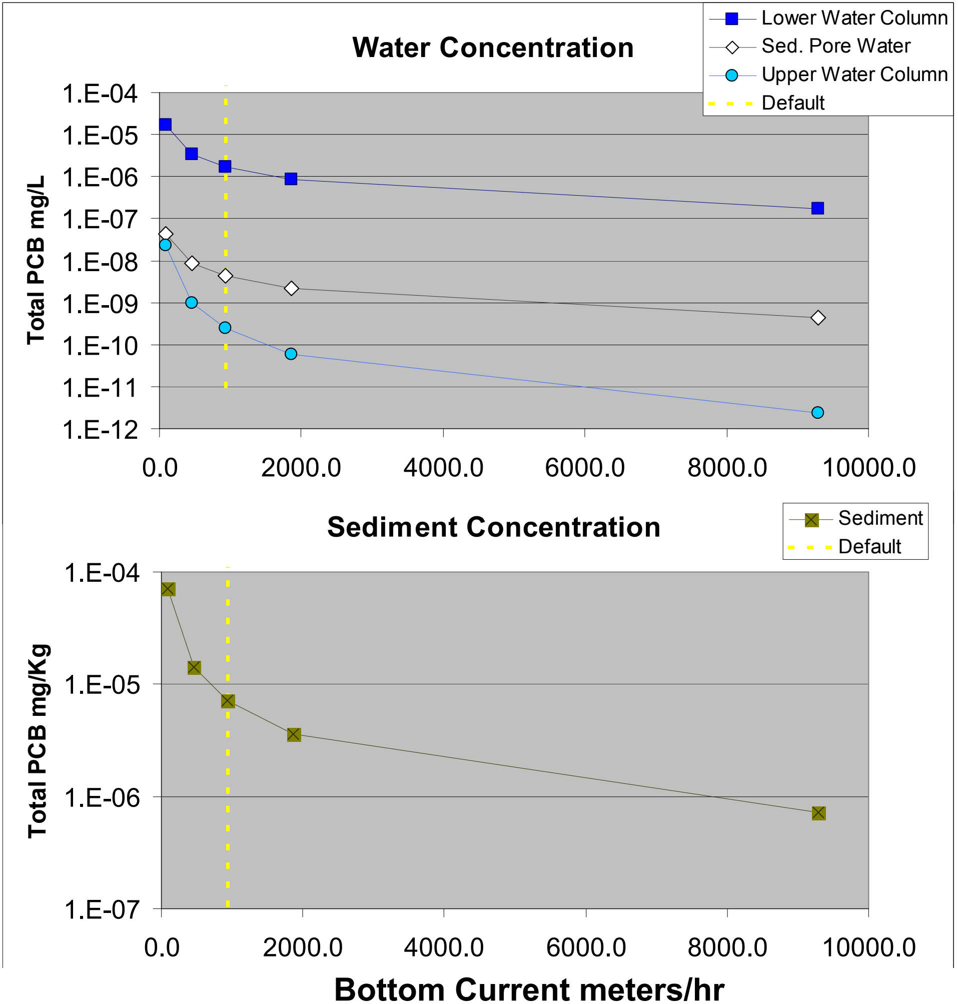


Fig. 57. Changes in water, sediment, and biota concentrations as function of PCB Release Rate. Default release rate is 7.62×10^{8} ng/day.



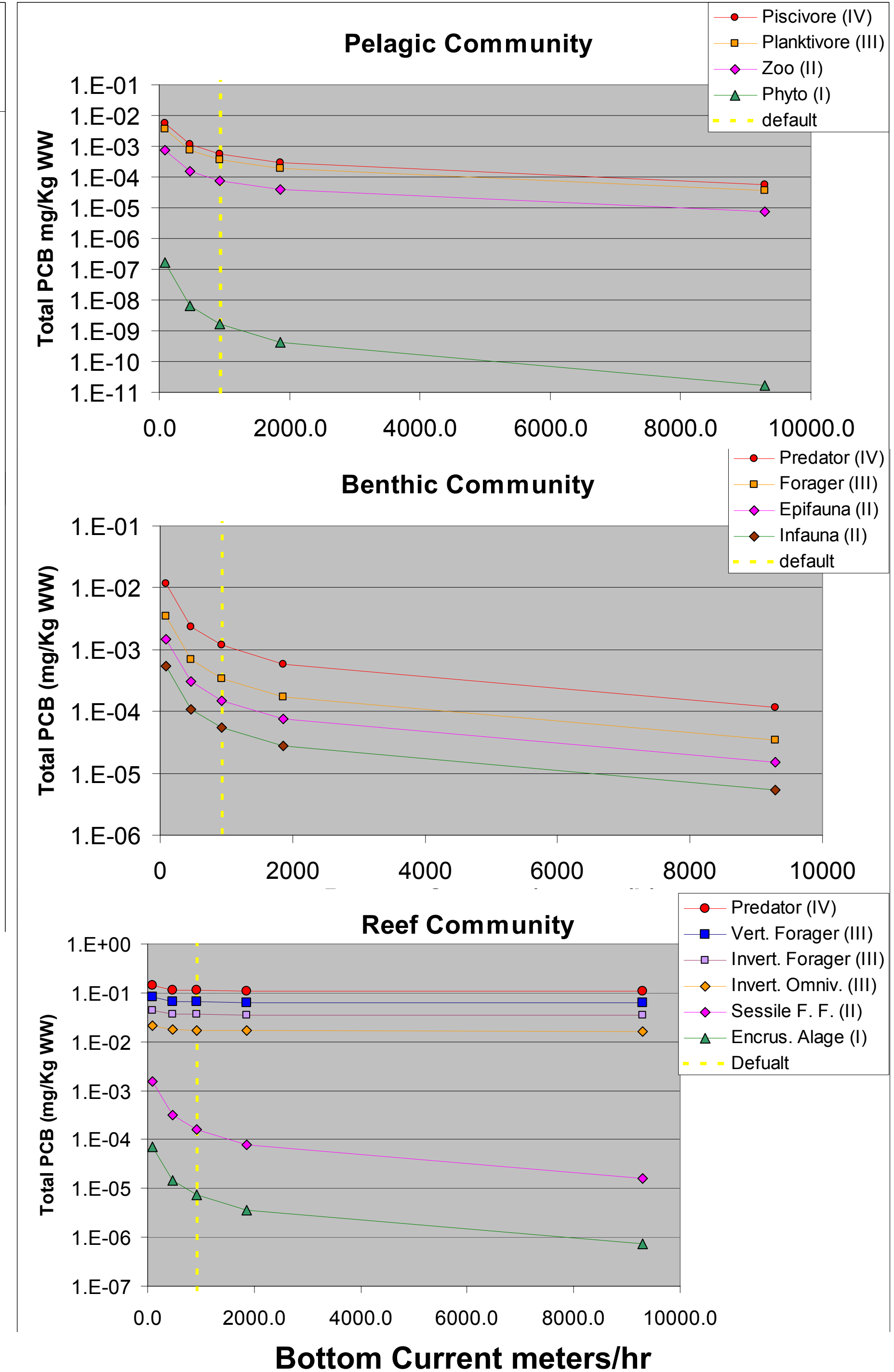
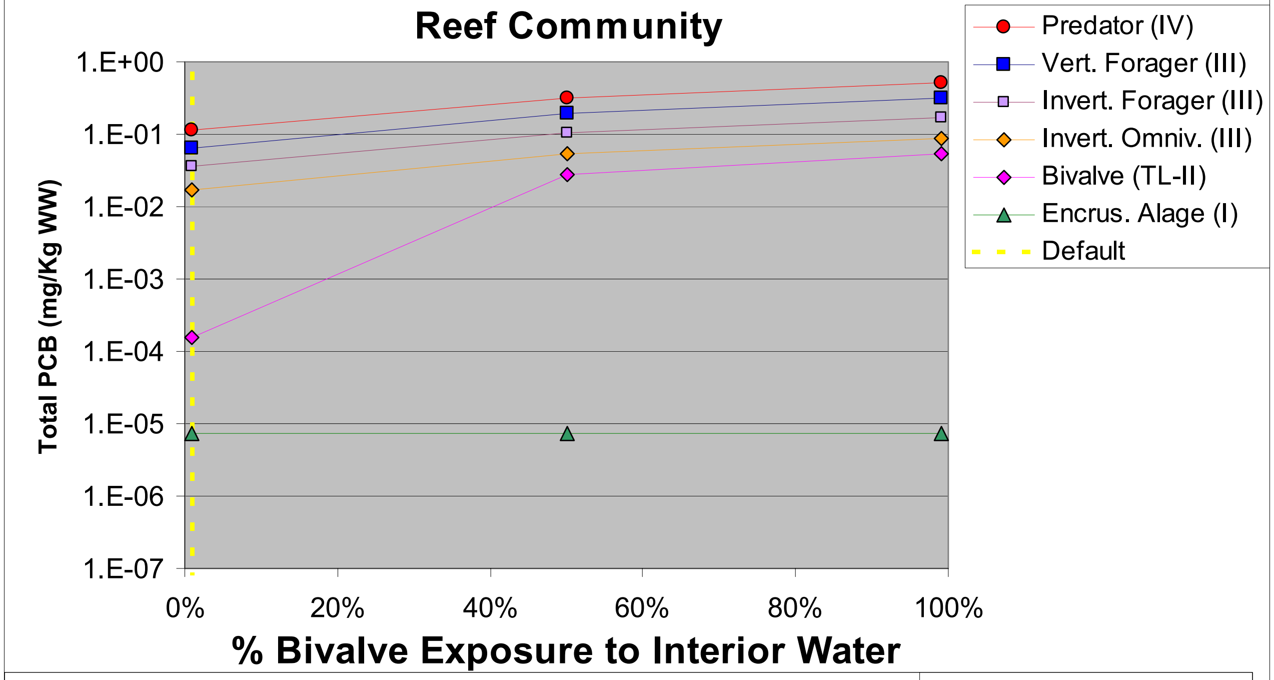


Fig. 58. Changes in water, sediment, and biota concentrations as function of bottom current. Default bottom current is 926 m/h.



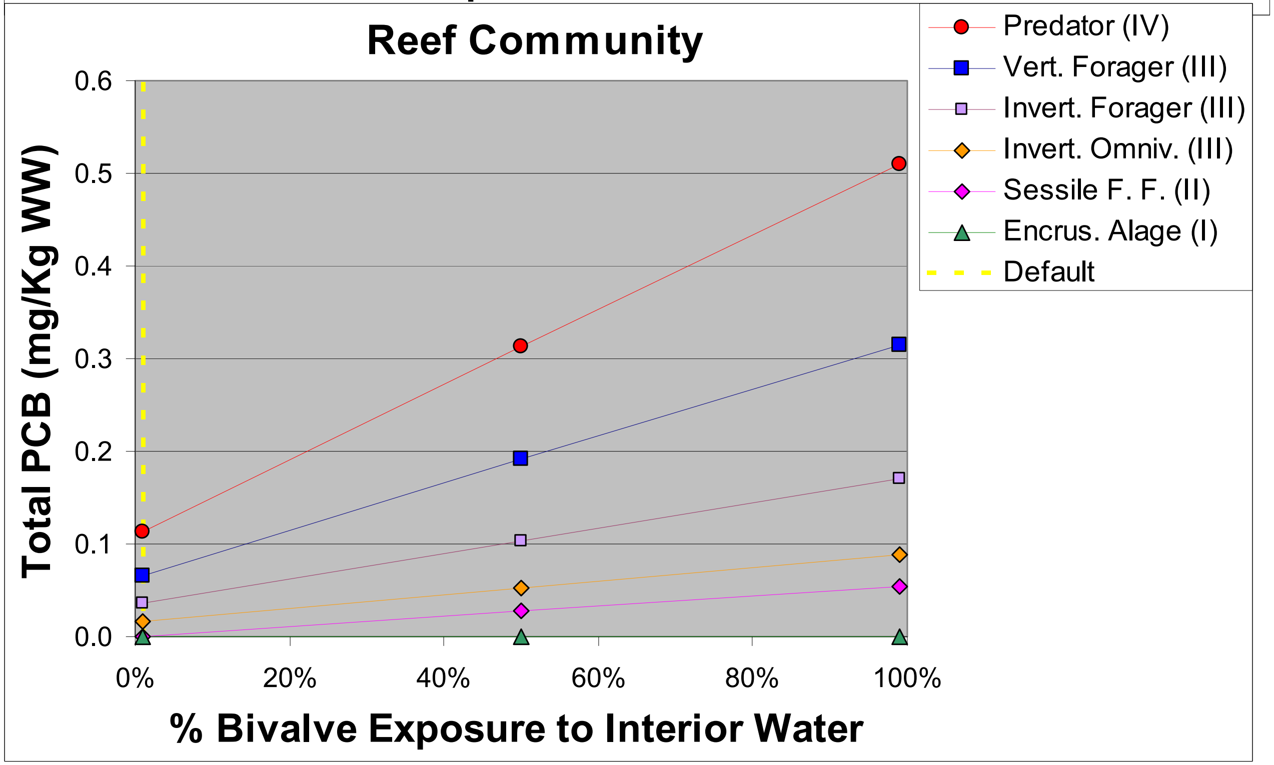


Fig. 59. Changes in concentrations of PCBs in the reef community as function of increasing bivalve exposure to interior vessel water. Default exposure is 0%.

Appendix A. Search Results from ERED Database

	Year	Author	Journal	Species	Common Name	Chemical	Conc Wet	Conc Units	Effect	Endpo	Exposure Route	Body Part	Life stage	Comments
	1972	Sanders, H.O., Chandler, J.H.	Bulletin of Environmental Contamination & Toxicology	Orconectes nais	Crayfish	Aroclor 1254	0.04	MG/KG	Mortality	NOED	Combined	Whole Body	Mature	Radiolabeled Compound
	1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.	Bull. Environ. Contam. Toxicol. 5:171-180.	Penaeus duorarum	Shrimp - Pink	PCBs	0.14	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Survival In 48 Hours
Invert. NOED	1991	Velduizen-Tsoerkan, M.B., Holwerda, D.A.,	Arch. Environ. Contam. Toxicol. 20: 259-265	Mytilus edulis	Mussel	PCBs	0.6	MG/KG	Mortality	NA	Combined	Whole Body	Adult	No Significant Decrease In Anoxic Survival Time (control 13 Days)
	1981	Mac, M.J. and J.G. Seelye	Bull. Environ. Contam. Toxicol. 27:359-367.	Salvelinus namaycush	Trout -Lake	PCBs	0.76	MG/KG	Growth	NOED	Absorption	Whole Body	Immature	Pcb Dosed With Acetone Carrier; No Effect On Growth (weight or
	1981	Mac, M.J. and J.G. Seelye	Bull. Environ. Contam. Toxicol. 27:359-367.	Salvelinus namaycush	Trout -Lake	PCBs	0.76	MG/KG	Growth	NOED	Absorption	Whole Body	Immature	Pcb With No Acetone Carrier; No Effect On Growth (weight or length)
	1981	Mac, M.J. and J.G. Seelye	Bull. Environ. Contam. Toxicol. 27:359-367.	Salvelinus namaycush	Trout -Lake	PCBs	0.76	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	Pcb Dosed With Acetone Carrier; No Effect On Mortality
	1981	Mac, M.J. and J.G. Seelye	Bull. Environ. Contam. Toxicol. 27:359-367.	Salvelinus namaycush	Trout -Lake	PCBs	0.76	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	Pcb With No Acetone Carrier; No Effect On Mortality
	1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	0.81	MG/KG	Mortality	NOED	Absorption	Whole Body	Egg-embryo	No Effect On Fry Mortality In 28 Days
	1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	0.84	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	No Effect On Adult Mortality In 28 Days
	1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.	Bull. Environ. Contam. Toxicol. 5:171-180.	Lagodon rhomboides	Pinfish	PCBs	0.98	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Survival In 48 Hours
	1972	Sanders, H.O., Chandler, J.H.	Bulletin of Environmental Contamination &	Corydalus cornutus	Midge	Aroclor 1254	1.02	MG/KG	Mortality	NOED	Combined	Whole Body	Immature	Radiolabeled Compound
Invert. LOED	1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Palaemonetes pugio	Shrimp - Grass	PCBs	1.1	MG/KG	Mortality	LOED	Absorption	Whole Body	Adult	33% Mortality In 96 Hours
	1972	Sanders, H.O., Chandler, J.H.	Bulletin of Environmental Contamination &	Chaoborus punctipennis	Midge	Aroclor 1254	1.2	MG/KG	Mortality	NOED	Combined	Whole Body	Immature	Radiolabeled Compound
	1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.	Bull. Environ. Contam. Toxicol. 5:171-180.	Penaeus duorarum	Shrimp - Pink	PCBs	1.3	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Survival In 48 Hours
	1975	Hogan, J.W., and J.L. Brauhn	The Progressive Fish Culturist 37 (4):229-230	Oncorhynchus mykiss	Trout - Rainbow	Aroclor 1242 or	1.3	MG/KG	Mortality	LOED	NA	Whole Body	Egg	10% Mortality
	1972	Sanders, H.O., Chandler, J.H.	Bulletin of Environmental Contamination &	Pteronarcys dorsata	Giant Black Stonefly	Aroclor 1254	1.4	MG/KG	Mortality	NOED	Combined	Whole Body	Immature	Radiolabeled Compound
	1991	Velduizen-Tsoerkan, M.B., Holwerda, D.A.,	Arch. Environ. Contam. Toxicol. 20: 259-265	Mytilus edulis	Mussel	PCBs	1.4	MG/KG	Mortality	NA	Combined	Whole Body	Adult	Decreased Anoxic Survival Time (control 10.7 Days)
	1991	Velduizen-Tsoerkan, M.B., Holwerda, D.A.,	Arch. Environ. Contam. Toxicol. 20: 259-265	Mytilus edulis	Mussel	PCBs	1.4	MG/KG	Physiolo	NOED	Combined	Whole Body	Adult	No Significant Changes In Adenylate Energy Charge Or
	1973	Sodergren, A., Svensson, B.	Bulletin of Environmental Contamination and	Ephemera danica	Mayfly	PCBs	1.5	MG/KG	Growth	NOED	Combined	Whole Body	Immature	
	1973	Sodergren, A., Svensson, B.	Bulletin of Environmental Contamination and	Ephemera danica	Mayfly	PCBs	1.5	MG/KG	Mortality	NOED	Combined	Whole Body	Immature	
Fish NOED	1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	1.5	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	No Effect On Adult Mortality In 28 Days
	1995	Boese, B.L., M. Winsor, H. Lee Li, S.	Environ. Toxicol. Chem. 14:303-310.	Macoma nasuta	Clam - Bent nose	PCBs	1.7	MG/KG	Mortality	NOED	Ingestion	Whole Body	Immature	No Effect On Mortality
Fish LOED 1	1981	Mac, M.J. and J.G. Seelye	Bull. Environ. Contam. Toxicol. 27:359-367.	Salvelinus namaycush	Trout -Lake	PCBs	1.8	MG/KG	Growth	LOED	Absorption	Whole Body	Immature	Pcb With No Acetone Carrier; Enhanced Growth (weight and
	1981	Mac, M.J. and J.G. Seelye	Bull. Environ. Contam. Toxicol. 27:359-367.	Salvelinus namaycush	Trout -Lake	PCBs	1.8	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	Pcb With No Acetone Carrier; No Effect On Mortality
	1981	Mac, M.J. and J.G. Seelye	Bull. Environ. Contam. Toxicol. 27:359-367.	Salvelinus namaycush	Trout -Lake	PCBs	2.1	MG/KG	Growth	NOED	Absorption	Whole Body	Immature	Pcb With No Acetone Carrier; No Effect On Growth (weight or length)

	Year	Author	Journal	Species	Common Name	Chemical	Conc Wet	Conc Units	Effect	Endpo	Exposure Route	Body Part	Life stage	Comments
	1981	Mac, M.J. and J.G. Seelye	Bull. Environ. Contam. Toxicol. 27:359-367.	Salvelinus namaycush	Trout -Lake	PCBs	2.1	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	Pcb With No Acetone Carrier; No Effect On Mortality
Fish LOED 2	1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Lagodon rhomboides	Pinfish	PCBs	2.2	MG/KG	Mortality	LOED	Absorption	Whole Body	Immature	5% Mortality In 96 Hours
	1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	2.3	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Juvenile Mortality In 28 Days
	1981	Mac, M.J. and J.G. Seelye	Bull. Environ. Contam. Toxicol. 27:359-367.	Salvelinus namaycush	Trout -Lake	PCBs	2.3	MG/KG	Growth	LOED	Absorption	Whole Body	Immature	Pcb Dosed With Acetone Carrier; Enhanced Growth (weight only; not
	1981	Mac, M.J. and J.G. Seelye	Bull. Environ. Contam. Toxicol. 27:359-367.	Salvelinus namaycush	Trout -Lake	PCBs	2.3	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	Pcb Dosed With Acetone Carrier; No Effect On Mortality
	1981	Mac, M.J. and J.G. Seelye	Bull. Environ. Contam. Toxicol. 27:359-367.	Salvelinus namaycush	Trout -Lake	PCBs	2.4	MG/KG	Growth	LOED	Absorption	Whole Body	Immature	Pcb Dosed With Acetone Carrier; Enhanced Growth (weight and
	1981	Mac, M.J. and J.G. Seelye	Bull. Environ. Contam. Toxicol. 27:359-367.	Salvelinus namaycush	Trout -Lake	PCBs	2.4	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	Pcb Dosed With Acetone Carrier; No Effect On Mortality
	1972	Sanders, H.O., Chandler, J.H.	Bulletin of Environmental Contamination &	Palaemonetes kadiakensis	Shrimp - Grass	Aroclor 1254	3.2	MG/KG	Mortality	NOED	Combined	Whole Body	Mature	Radiolabeled Compound
	1980	Hawkes, J.W., E.H. Gruger, Jr. and O.P. Olson	Environ. Res. 23:149-161.	Oncorhynchus tshawytscha	Salmon - Chinook	PCBs	3.5	MG/KG	Cellular	LOED	Ingestion	Whole Body	Immature	Structure Changes In Intestine Cells, Increased Exfoliation Of Mucosa, Mucosal Cell Inclusions
	1980	Hawkes, J.W., E.H. Gruger, Jr. and O.P.	Environ. Res. 23:149-161.	Oncorhynchus tshawytscha	Salmon - Chinook	PCBs	3.5	MG/KG	Growth	NOED	Ingestion	Whole Body	Immature	No Effect On Weight Gain
	1979	Broyles, R.H. and M.I. Noveck	Toxicology and Applied Pharmacology 50, 299-	Oncorhynchus tshawytscha	Salmon - Chinook	2,4,6,2`-tetrachl	3.7	MG/KG	Survival	LC28	Combined	Whole Body	Fry	
	1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.	Bull. Environ. Contam. Toxicol. 5:171-180.	Lagodon rhomboides	Pinfish	PCBs	3.8	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Survival In 48 Hours
	1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Penaeus aztecus	Shrimp - Brown	PCBs	3.8	MG/KG	Mortality	LOED	Absorption	Whole Body	NA	8% Mortality In 96 Hours
	1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.	Bull. Environ. Contam. Toxicol. 5:171-180.	Penaeus duorarum	Shrimp - Pink	PCBs	3.9	MG/KG	Mortality	ED10(	Absorption	Whole Body	Immature	100% Mortality After 48 Hours
	1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Crassostrea virginica	Oyster	PCBs	4	MG/KG	Growth	ED10	Absorption	Whole Body	Adult	Reduction In Shell Growth
	1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	4.2	MG/KG	Developi	NOED	Absorption	Whole Body	Egg-embryo	No Effect On Fertilization Success, Survival Of Embryos To Hatching,
shark NOED	1983	Westin, D.T., Olney, C.E., Rogers, B.A.	Bull. Environm. Contam. Toxicol. 30: 50-57	Morone saxatilis	Striped Bass	PCBs	4.4	MG/KG	Growth	NOED	Ingestion	Whole Body	Immature	Parental Exposure To Pcbs In Field, Then Post Yolk Absorption
	1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	4.9	MG/KG	Mortality	NOED	Absorption	Whole Body	Egg-embryo	No Effect On Fry Mortality In 28 Days
	1972	Sanders, H.O., Chandler, J.H.	Bulletin of Environmental Contamination &	Culex tarsalis	Mosquito	Aroclor 1254	5.4	MG/KG	Mortality	NOED	Combined	Whole Body	Immature	Radiolabeled Compound
	1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	5.4	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	No Effect On Adult Mortality In 28 Days
	1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	5.9	MG/KG	Mortality	NOED	Absorption	Whole Body	Egg-embryo	No Effect On Fry Mortality In 28 Days
shark LOED	1988	Black, D.E., D.K. Phelps and R.L. Lapan	Mar. Environ. Res. 25:45-62.	Pleuronectes americanus	Winter Flounder	PCBs	7.1	MG/KG	Growth	LOED	Combined	Whole Body	Egg-embryo	Reduced Length And Weight Of Larvae
	1972	Sanders, H.O., Chandler, J.H.	Bulletin of Environmental Contamination &	Gammarus pseudolimnaeu	Amphipod	Aroclor 1254	7.8	MG/KG	Mortality	NOED	Combined	Whole Body	Mature	Radiolabeled Compound
	1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.	Bull. Environ. Contam. Toxicol. 5:171-180.	Crassostrea virginica	Oyster	PCBs	8.1	MG/KG	Growth	NA	Absorption	Whole Body	Immature	19% Reduction In Rate Of Shell Growth
	1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.	Bull. Environ. Contam. Toxicol. 5:171-180.	Crassostrea virginica	Oyster	PCBs	8.1	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Survival In 96 Hours

	Year	Author	Journal	Species	Common Name	Chemical	Conc Wet	Conc Units	Effect	Endpo	Exposure Route	Body Part	Life stage	Comments
	1979	Broyles, R.H. and M.I. Noveck	Toxicology and Applied Pharmacology 50, 299-	Salvelinus namaycush	Trout -Lake	2,4,6,2`-tetrachl	8.4	MG/KG	Survival	LC87	Combined	Whole Body	Fry	
	1979	Broyles, R.H. and M.I. Noveck	Toxicology and Applied Pharmacology 50, 299-	Salvelinus namaycush	Trout -Lake	2,4,6,2`-tetrachl	8.6	MG/KG	Survival	LC74	Combined	Whole Body	Fry	
	1979	Broyles, R.H. and M.I. Noveck	Toxicology and Applied Pharmacology 50, 299-	Salvelinus namaycush	Trout -Lake	2,4,6,2`-tetrachl	8.8	MG/KG	Survival	LC17	Combined	Whole Body	Fry	
	1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	8.9	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Juvenile Mortality In 28 Days
	1979	Broyles, R.H. and M.I. Noveck	Toxicology and Applied Pharmacology 50, 299-	Salvelinus namaycush	Trout -Lake	2,4,6,2`-tetrachl	9.2	MG/KG	Survival	LC50	Combined	Whole Body	Fry	
	1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	10	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Juvenile Mortality In 28 Days
	1972	Sanders, H.O., Chandler, J.H.	Bulletin of Environmental Contamination &	Daphnia magna	Water flea	Aroclor 1254	10.4	MG/KG	Mortality	NOED	Combined	Whole Body	Mature	Radiolabeled Compound
	1976	Hansen, L.G., W.B. Wiekhorst and J. Simon	J. Fish. Res. Bd. Can. 33:1343-1352.	Ictalurus punctatus	Catfish-Channel	PCBs	10.9	MG/KG	Cellular	NOED	Ingestion	Whole Body	Immature	No Effect On Histopathology Of Liver, Brain, Kidney
	1976	Hansen, L.G., W.B. Wiekhorst and J.	J. Fish. Res. Bd. Can. 33:1343-1352.	Ictalurus punctatus	Catfish-Channel	PCBs	10.9	MG/KG	Mortality	NOED	Ingestion	Whole Body	Immature	No Effect On Mortality
	1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	11	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Juvenile Mortality In 28 Days
	1977	Neff, J.M., Giam, C.S.	Reference Not Available	Limulus polyphemus	Crab - Horseshoe	Aroclor 1016 or	11.2	MG/KG	Growth	NA	Absorption	Whole Body	Immature	Delayed Molting; Less Than 50% Molted After 96 Days Starting With
	1977	Neff, J.M., Giam, C.S.	Reference Not Available	Limulus polyphemus	Crab - Horseshoe	Aroclor 1016 or	11.2	MG/KG	Mortality	NA	Absorption	Whole Body	Immature	Less Than 50% Mortality Starting With T2-stage Crabs
	1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	12	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	No Effect On Adult Mortality In 28 Days
	1976	Hansen, L.G., W.B. Wiekhorst and J.	J. Fish. Res. Bd. Can. 33:1343-1352.	Ictalurus punctatus	Catfish-Channel	PCBs	14.3	MG/KG	Growth	LOED	Ingestion	Whole Body	Immature	40% Reduction In Mean Weight
	1976	Hansen, L.G., W.B. Wiekhorst and J.	J. Fish. Res. Bd. Can. 33:1343-1352.	Ictalurus punctatus	Catfish-Channel	PCBs	14.3	MG/KG	Morphol	LOED	Ingestion	Whole Body	Immature	Inreased Size Of Liver
	1976	Hansen, L.G., W.B. Wiekhorst and J. Simon	J. Fish. Res. Bd. Can. 33:1343-1352.	Ictalurus punctatus	Catfish-Channel	PCBs	14.3	MG/KG	Cellular	NOED	Ingestion	Whole Body	Immature	No Effect On Histopathology Of Liver, Brain, Kidney
	1976	Hansen, L.G., W.B. Wiekhorst and J.	J. Fish. Res. Bd. Can. 33:1343-1352.	Ictalurus punctatus	Catfish-Channel	PCBs	14.3	MG/KG	Mortality	NOED	Ingestion	Whole Body	Immature	No Effect On Mortality
	1980	Bengtsson, B.E.	Water Res. 14:681-687.	Phoxinus phoxinus	Minnow	PCBs	15	MG/KG	Reprodu	LOED	Ingestion	Whole Body	Adult	Reduction In Time To Hatch, Fry Death
	1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.	Bull. Environ. Contam. Toxicol. 5:171-180.	Penaeus duorarum	Shrimp - Pink	PCBs	16	MG/KG	Mortality	NA	Absorption	Whole Body	Immature	Lethal To 18 Of 25 Fish In 20 Days
	1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.	Bull. Environ. Contam. Toxicol. 5:171-180.	Lagodon rhomboides	Pinfish	PCBs	17	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Survival In 48 Hours
	1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	17	MG/KG	Develop	NOED	Absorption	Whole Body	Egg-embryo	No Effect On Fertilization Success, Survival Of Embryos To Hatching,
	1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Lagodon rhomboides	Pinfish	PCBs	21	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Mortality In 96 Hours
	1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Palaemonetes pugio	Shrimp - Grass	PCBs	22	MG/KG	Mortality	NA	Absorption	Whole Body	Adult	38% Mortality In 96 Hours
	1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	22	MG/KG	Mortality	NOED	Absorption	Whole Body	Egg-embryo	No Effect On Fry Mortality In 28 Days
	1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	22	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	No Effect On Adult Mortality In 28 Days

Year	Author	Journal	Species	Common Name	Chemical	Conc Wet	Conc Units	Effect	Endpc	Exposure Route	Body Part	Life stage	Comments
1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.	Bull. Environ. Contam. Toxicol. 5:171-180.	Callinectes sapidus	Crab - Blue	PCBs	23	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Survival In 20 Days
1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	26	MG/KG	Mortality	NOED	Absorption	Whole Body	Egg-embryo	No Effect On Fry Mortality In 28 Days
1986	Carlberg, G.E., K. Martinsen, A.	Arch. Environ. Contam. Toxicol. 15:543-548.	Salmo salar	Salmon - Atlantic	PCBs	30	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Mortality
1990	Borgmann, U., N.P. Norwood, and K.M.	Arch. Environ. Contam. Toxicol., 19:558-564	Hyalella azteca	Amphipod - Freshwater	Aroclor 1242 or	30	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	Radiolabeled Compounds, Exp_conc = 3-100
1977	Neff, J.M., Giam, C.S.	Reference Not Available	Limulus polyphemus	Crab - Horseshoe	Aroclor 1016 or	31.9	MG/KG	Growth	NA	Absorption	Whole Body	Immature	Delayed Molting; Less Than 50% Molted After 96 Days Starting With
1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Crassostrea virginica	Oyster	PCBs	32	MG/KG	Growth	NA	Absorption	Whole Body	Adult	Reduction In Shell Growth
1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.	Bull. Environ. Contam. Toxicol. 5:171-180.	Crassostrea virginica	Oyster	PCBs	33	MG/KG	Growth	NA	Absorption	Whole Body	Immature	41% Reduction In Rate Of Shell Growth
1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.	Bull. Environ. Contam. Toxicol. 5:171-180.	Crassostrea virginica	Oyster	PCBs	33	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Survival In 96 Hours
1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.	Bull. Environ. Contam. Toxicol. 5:171-180.	Penaeus duorarum	Shrimp - Pink	PCBs	33	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Survival In 20 Days
1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	38	MG/KG	Mortality	NOED	Absorption	Whole Body	Egg-embryo	No Effect On Fry Mortality In 28 Days
1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Penaeus aztecus	Shrimp - Brown	PCBs	42	MG/KG	Mortality	NA	Absorption	Whole Body	NA	43% Mortality In 96 Hours
1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Palaemonetes pugio	Shrimp - Grass	PCBs	44	MG/KG	Mortality	NA	Absorption	Whole Body	Adult	93% Mortality In 96 Hours
1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	46	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	No Effect On Adult Mortality In 28 Days
1990	Hermens, J.L., S.P. Bradbury and S.J.	Ecotoxicol. Environ. Saf. 20:156-166.	Oncorhynchus mykiss	Trout - Rainbow	PCBs	50	MG/KG	Physiolo	LOED	NA	Whole Body	Immature	Mixed Function Oxidase Induction, Including Benzo(a)pyrene
1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	54	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Juvenile Mortality In 28 Days
1990	Borgmann, U., N.P. Norwood, and K.M.	Arch. Environ. Contam. Toxicol., 19:558-564	Hyalella azteca	Amphipod - Freshwater	PCB 52	54	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	Radiolabeled Compounds, Exp_conc = 3-100
1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	57	MG/KG	Mortality	NOED	Absorption	Whole Body	Egg-embryo	No Effect On Fry Mortality In 28 Days
1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Lagodon rhomboides	Pinfish	PCBs	65	MG/KG	Mortality	NA	Absorption	Whole Body	Immature	18% Mortality In 96 Hours
1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	66	MG/KG	Developi	NOED	Absorption	Whole Body	Egg-embryo	No Effect On Fertilization Success, Survival Of Embryos To Hatching,
1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	79	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Juvenile Mortality In 28 Days
1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Crassostrea virginica	Oyster	PCBs	95	MG/KG	Growth	NA	Absorption	Whole Body	Adult	Reduction In Shell Growth
1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	100	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	No Effect On Adult Mortality In 28 Days
1990	Hermens, J.L., S.P. Bradbury and S.J.	Ecotoxicol. Environ. Saf. 20:156-166.	Oncorhynchus mykiss	Trout - Rainbow	PCBs	100	MG/KG	Physiolo	NA	NA	Whole Body	Immature	Mixed Function Oxidase Induction, Including Benzo(a)pyrene
1972	Lowe, J.I., P.R. Parrish, J.M. Patrick, Jr. and J. Forester	Mar. Biol. 17:209-214.	Crassostrea virginica	Oyster	PCBs	101	MG/KG	Cellular	NOED	Absorption	Whole Body	Immature	No Effect On Histopathology Of Digestive Diverticulata
1972	Lowe, J.I., P.R. Parrish, J.M. Patrick,	Mar. Biol. 17:209-214.	Crassostrea virginica	Oyster	PCBs	101	MG/KG	Growth	NOED	Absorption	Whole Body	Immature	No Effect On Growth

Year	Author	Journal	Species	Common Name	Chemical	Conc Wet	Conc Units	Effect	Endpo	Exposure Route	Body Part	Life stage	Comments
1972	Lowe, J.I., P.R. Parrish, J.M. Patrick,	Mar. Biol. 17:209-214.	Crassostrea virginica	Oyster	PCBs	101	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Mortality
1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Lagodon rhomboides	Pinfish	PCBs	106	MG/KG	Mortality	ED50	Absorption	Whole Body	Immature	50% Mortality
1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Lagodon rhomboides	Pinfish	PCBs	106	MG/KG	Cellular	LOED	Absorption	Whole Body	Immature	Liver And Pancreatic Cell Alterations
1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Lagodon rhomboides	Pinfish	PCBs	106	MG/KG	Mortality	LOED	Absorption	Whole Body	Immature	Statistically Significant Increase In Mortality
1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	110	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	No Effect On Adult Mortality In 28 Days
1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Lagodon rhomboides	Pinfish	PCBs	111	MG/KG	Cellular	NOED	Absorption	Whole Body	Immature	No Incidence Of Pathology (liver And Pancreatic Alterations)
1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Lagodon rhomboides	Pinfish	PCBs	111	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Statistically Significant Increase In Mortality
1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Lagodon rhomboides	Pinfish	PCBs	111	MG/KG	Physiolo	NOED	Absorption	Whole Body	Immature	No Reduced Ability To Survive Osmotic Stress After Exposure
1985	Freitag, D., L. Ballhorn, H. Geyer and F. Korte	Chemosphere 14:1589-1616.	Leuciscus idus	Golden Ide	2,4,6,2`,4`-	116	MG/KG	Mortality	NOED	Absorption	Whole Body	NA	No Effect On Survivorship In 3 Days
1985	Freitag, D., L. Ballhorn, H. Geyer and F. Korte	Chemosphere 14:1589-1616.	Leuciscus idus	Golden Ide	2,2` - DBCP	121	MG/KG	Mortality	NOED	Absorption	Whole Body	NA	No Effect On Survivorship In 3 Days
1985	Freitag, D., L. Ballhorn, H. Geyer and F. Korte	Chemosphere 14:1589-1616.	Leuciscus idus	Golden Ide	2,4,6,2`-tetrachl	158	MG/KG	Mortality	NOED	Absorption	Whole Body	NA	No Effect On Survivorship In 3 Days
1995	Van Wezel, A.P., Punte, S.S.,	Environ. Toxicol. Chem. 14: 1579-1585	Pimephales promelas	Fathead minnow	PCB 1	167	MG/KG	Mortality	ED10(	Absorption	Whole Body	Adult	Lethal Body Burden Measured Ir Fish Immediately After Death;
1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Lagodon rhomboides	Pinfish	PCBs	170	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Statistically Significant Increase In Mortality
1980	Bengtsson, B.E.	Water Res. 14:681-687.	Phoxinus phoxinus	Minnow	PCBs	170	MG/KG	Growth	LOED	Ingestion	Whole Body	Adult	Increased Growth
1980	Bengtsson, B.E.	Water Res. 14:681-687.	Phoxinus phoxinus	Minnow	PCBs	170	MG/KG	Mortality	LOED	Ingestion	Whole Body	Adult	Doubling Of Mortality Rate Compared To Controls After 300
1980	Bengtsson, B.E.	Water Res. 14:681-687.	Phoxinus phoxinus	Minnow	PCBs	170	MG/KG	Reprodu	NA	Ingestion	Whole Body	Adult	85% Reduction In Hatchability Of Eggs
1985	Freitag, D., L. Ballhorn, H. Geyer and F. Korte	Chemosphere 14:1589-1616.	Leuciscus idus	Golden Ide	2,4`-dichloro	178	MG/KG	Mortality	NOED	Absorption	Whole Body	NA	No Effect On Survivorship In 3 Days
1985	Freitag, D., L. Ballhorn, H. Geyer and F. Korte	Chemosphere 14:1589-1616.	Leuciscus idus	Golden Ide	PCB 31	193	MG/KG	Mortality	NOED	Absorption	Whole Body	NA	No Effect On Survivorship In 3 Days
1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	200	MG/KG	Mortality	LOED	Absorption	Whole Body	Egg-embryo	Lethal To 86% Of Fry In 28 Days
1990	Hermens, J.L., S.P. Bradbury and S.J.	Ecotoxicol. Environ. Saf. 20:156-166.	Oncorhynchus mykiss	Trout - Rainbow	PCBs	200	MG/KG	Physiolo	NA	NA	Whole Body	Immature	Mixed Function Oxidase Induction, Including Benzo(a)pyrene
1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Lagodon rhomboides	Pinfish	PCBs	205	MG/KG	Mortality	ED50	Absorption	Whole Body	Immature	50% Mortality
1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Lagodon rhomboides	Pinfish	PCBs	205	MG/KG	Morpholo	LOED	Absorption	Whole Body	Immature	Darkened Coloration
1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	220	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Juvenile Mortality In 28 Days
1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	230	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Juvenile Mortality In 28 Days

	Year	Author	Journal	Species	Common Name	Chemical	Conc Wet	Conc Units	Effect	Endpo	Exposure Route	Body Part	Life stage	Comments
	1972	Hattula, M.I. and O. Karlog	Acta Pharmacol. Toxicol. 31:238-240.	Carassius auratus	Goldfish	PCBs	250	MG/KG	Mortality	ED50	Absorption	Whole Body	Immature	Lethal Body Burden
	1972	Hattula, M.I. and O. Karlog	Acta Pharmacol. Toxicol. 31:238-240.	Carassius auratus	Goldfish	PCBs	250	MG/KG	Morpholo	LOED	Absorption	Whole Body	Immature	Color Changes
	1972	Hattula, M.I. and O. Karlog	Acta Pharmacol. Toxicol. 31:238-240.	Carassius auratus	Goldfish	PCBs	253	MG/KG	Mortality	ED50	Absorption	Whole Body	Immature	Lethal Body Burden
	1972	Hattula, M.I. and O. Karlog	Acta Pharmacol. Toxicol. 31:238-240.	Carassius auratus	Goldfish	PCBs	256	MG/KG	Mortality	ED50	Absorption	Whole Body	Immature	Lethal Body Burden
	1972	Hattula, M.I. and O. Karlog	Acta Pharmacol. Toxicol. 31:238-240.	Carassius auratus	Goldfish	PCBs	271	MG/KG	Mortality	ED50	Absorption	Whole Body	Immature	Lethal Body Burden
	1972	Hattula, M.I. and O. Karlog	Acta Pharmacol. Toxicol. 31:238-240.	Carassius auratus	Goldfish	PCBs	293	MG/KG	Mortality	ED50	Absorption	Whole Body	Immature	Lethal Body Burden
	1972	Hattula, M.I. and O. Karlog	Acta Pharmacol. Toxicol. 31:238-240.	Carassius auratus	Goldfish	PCBs	324	MG/KG	Mortality	ED50	Absorption	Whole Body	Immature	Lethal Body Burden
	1972	Lowe, J.I., P.R. Parrish, J.M. Patrick, Jr. and J. Forester	Mar. Biol. 17:209-214.	Crassostrea virginica	Oyster	PCBs	425	MG/KG	Cellular	LOED	Absorption	Whole Body	Immature	Atrophy Of Digestive Diverticulata
	1972	Lowe, J.I., P.R. Parrish, J.M. Patrick,	Mar. Biol. 17:209-214.	Crassostrea virginica	Oyster	PCBs	425	MG/KG	Growth	LOED	Absorption	Whole Body	Immature	Reduced Growth
	1972	Lowe, J.I., P.R. Parrish, J.M. Patrick,	Mar. Biol. 17:209-214.	Crassostrea virginica	Oyster	PCBs	425	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Mortality
	1974	Hansen, D.J., P.R. Parrish and J. Forester	Environ. Res. 7:363-373.	Lagodon rhomboides	Pinfish	PCBs	620	MG/KG	Mortality	LOED	Absorption	Whole Body	Immature	Statistically Significant Increase In Mortality
	1977	Mayer, F.L., P.M. Mehrle, and H.O.	Arch. Environ. Contam. 5:501-511	Oncorhynchus kisutch	Salmon-coho	PCBs	645	MG/KG	Mortality	ED100	Ingestion	Whole Body	Immature	Radiolabeled - Contam. Food Fed.
	1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	1100	MG/KG	Morpholo	LOED	Absorption	Whole Body	Immature	Darkened Body Coloration, Body Lesions
	1975	Hansen, D.J., S.C. Schimmel and J.	Trans. Amer. Fish. Soc. 104:584-588.	Cyprinodon variegatus	Sheepshead minnow	PCBs	1100	MG/KG	Mortality	LOED	Absorption	Whole Body	Immature	88% Juvenile Mortality In 28 Days

Appendix B. PRAM Output for Varying ZOI

B.1 PRAM Output ZOI = 1

B.2 PRAM Default Parameters (ZOI =2)

B.3 PRAM Output ZOI = 3

B.4 PRAM Output ZOI = 4

B.5 PRAM Output ZOI = 5

B.6 PRAM Output ZOI = 10

B.7 Summary of Total PCBs concentrations modeled for biological and abiotic compartments as a function of ZOI.

Scenario Run on 5/31/05 14:31 ZOI = 1

PCB Homolog	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Molecular Weight (g/mol)	1.89E+02	2.23E+02	2.58E+02	2.92E+02	3.26E+02	3.61E+02	3.95E+02	4.30E+02	4.64E+02	4.99E+02
Solubility (mg/L)	2.91E+00	6.78E-01	8.14E-02	6.67E-02	2.61E-02	9.50E-04	2.30E-04	2.11E-08	4.02E-09	1.69E-10
Solubility (mol/m^3)	1.54E-02	3.04E-03	3.16E-04	2.28E-04	8.00E-05	2.63E-06	5.82E-07	4.91E-11	8.65E-12	3.38E-13
Vapor Pressure (Pa)	6.32E-01	1.41E-01	5.11E-02	2.08E-02	2.96E-03	3.43E-03	2.56E-04	8.65E-05	2.77E-05	1.41E-05
Henry's (Pa-m^3/mol)	4.10E+01	4.65E+01	1.62E+02	9.10E+01	3.70E+01	1.30E+03	4.40E+02	1.76E+06	3.20E+06	4.18E+07
$\log_{10}K_{ow}$ =	4.47	5.24	5.52	5.92	6.50	6.98	7.19	7.70	8.35	9.60
$\log_{10}K_{oc}$ =	3.66	4.06	4.63	4.65	4.94	6.08	6.34	6.46	6.97	7.94
$\log_{10}K_{doc}$ =	3.34	4.11	4.39	4.79	5.51	5.85	6.06	6.57	7.22	8.47
Chemical emission rate (g/day)	1.37E-05	1.12E-01	9.95E-03	1.69E-01	3.20E-01	7.57E-02	7.37E-02	0.00E+00	8.28E-04	4.62E-04
Chemical emission rate (mol/hr)	3.03E-09	2.09E-05	1.61E-06	2.42E-05	4.08E-05	8.74E-06	7.77E-06	0.00E+00	7.43E-08	3.86E-08
Biodegradation in sediment (1/hr)	0	0	0	0	0	0	0	0	0	0
Biodegradation in water (1/hr)	0	0	0	0	0	0	0	0	0	0

	Ventilation Gaskets	Lubricants	Foam Rubber Material	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint
Fraction PCB in Material (wt/wt)	0.0000314	0.000103	0.76%	0.0000529	0.00185	0.000537	0.00002
Material Mass Onboard (kg)	1459	0	0	5397	296419	14379	386528
Total PCBs (kg)	0.0458126	0	0	0.2855013	548.37515	7.721523	7.73056
Total PCB Release rate (ng/g-PCB per day)	1.58E+03	2.20E+03	2.62E+00	1.58E+03	2.79E+02	6.76E+04	1.11E+04

Release Rates in nanograms PCB per gram of PCB within the Material	Ventilation Gaskets	Lubricants	Foam Rubber Material	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint
Monochlorobiphenyl	4.14E+01	3.47E+01	0.00E+00	4.14E+01	0.00E+00	0.00E+00	0.00E+00
Dichlorobiphenyl	1.27E+03	1.72E+02	3.08E-02	1.27E+03	2.03E+02	5.36E+00	0.00E+00
Trichlorobiphenyl	5.66E+01	8.97E+01	7.63E-02	5.66E+01	1.14E+00	9.44E+02	2.61E+02
Tetrachlorobiphenyl	1.44E+02	1.08E+03	1.29E+00	1.44E+02	1.57E+01	2.07E+04	1.23E+02
Pentachlorobiphenyl	6.31E+01	6.60E+02	3.90E-02	6.31E+01	1.80E+01	3.79E+04	2.24E+03
Hexachlorobiphenyl	0.00E+00	9.42E+01	5.34E-01	0.00E+00	2.41E+01	6.76E+03	1.33E+03
Heptachlorobiphenyl	5.04E+00	7.17E+01	6.46E-01	5.04E+00	1.47E+01	1.30E+03	7.19E+03
Octachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nonachlorobiphenyl	0.00E+00	0.00E+00	1.72E-03	0.00E+00	1.51E+00	0.00E+00	0.00E+00
Decachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.43E-01	0.00E+00	0.00E+00
Total	**1.58E+03**	**2.20E+03**	**2.62E+00**	**1.58E+03**	**2.79E+02**	**6.76E+04**	**1.11E+04**

Release Rates in nanograms PCB per Day	Ventilation Gaskets	Lubricants	Foam Rubber Material	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint	Total
Monochlorobiphenyl	1.90E+03	0.00E+00	0.00E+00	1.18E+04	0.00E+00	0.00E+00	0.00E+00	1.37E+04
Dichlorobiphenyl	5.80E+04	0.00E+00	0.00E+00	3.62E+05	1.11E+08	4.14E+04	0.00E+00	1.12E+08
Trichlorobiphenyl	2.59E+03	0.00E+00	0.00E+00	1.62E+04	6.25E+05	7.29E+06	2.02E+06	9.95E+06
Tetrachlorobiphenyl	6.60E+03	0.00E+00	0.00E+00	4.11E+04	8.61E+06	1.60E+08	9.51E+05	1.69E+08
Pentachlorobiphenyl	2.89E+03	0.00E+00	0.00E+00	1.80E+04	9.87E+06	2.93E+08	1.73E+07	3.20E+08
Hexachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E+07	5.22E+07	1.03E+07	7.57E+07
Heptachlorobiphenyl	2.31E+02	0.00E+00	0.00E+00	1.44E+03	8.06E+06	1.01E+07	5.56E+07	7.37E+07
Octachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nonachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.28E+05	0.00E+00	0.00E+00	8.28E+05
Decachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.62E+05	0.00E+00	0.00E+00	4.62E+05
Total	7.23E+04	0.00E+00	0.00E+00	4.50E+05	1.53E+08	5.22E+08	8.62E+07	7.62E+08

Air	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	2.53E-20	1.56E-16	1.02E-17	1.37E-16	1.50E-16	5.28E-18	1.89E-18	0.00E+00	6.69E-22	2.15E-24
Air concentration (g/m3)	1.95E-21	1.42E-17	1.07E-18	1.63E-17	2.00E-17	7.77E-19	3.04E-19	0.00E+00	1.26E-22	4.37E-25

Upper Water Column	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	7.42E-18	5.61E-14	1.36E-14	1.10E-13	5.24E-14	6.67E-14	8.42E-15	0.00E+00	2.34E-14	1.02E-15
Water concentration (mg/L)	3.41E-17	2.69E-13	2.17E-14	3.51E-13	4.62E-13	1.85E-14	7.56E-15	0.00E+00	3.41E-18	1.22E-20
Suspended solids concentration (mg/kg)	2.36E-14	4.61E-10	1.37E-10	2.38E-09	5.96E-09	3.33E-09	2.48E-09	0.00E+00	4.72E-12	1.60E-13
Dissolved organic carbon (mg/kg)	7.53E-14	3.43E-09	5.32E-10	2.17E-08	1.50E-07	1.29E-08	8.66E-09	0.00E+00	5.65E-11	3.62E-12

Lower Water Column	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	3.70E-14	2.84E-10	7.24E-11	5.98E-10	3.43E-10	1.06E-09	2.07E-10	0.00E+00	2.87E-09	1.56E-09
Water concentration (mg/L)	1.70E-13	1.36E-09	1.15E-10	1.92E-09	3.02E-09	2.94E-10	1.85E-10	0.00E+00	4.17E-13	1.87E-14
Suspended solids concentration (mg/kg)	1.18E-10	2.34E-06	7.30E-07	1.30E-05	3.90E-05	5.30E-05	6.09E-05	0.00E+00	5.78E-07	2.44E-07
Dissolved organic carbon (mg/kg)	3.75E-10	1.74E-05	2.83E-06	1.19E-04	9.85E-04	2.06E-04	2.13E-04	0.00E+00	6.93E-06	5.53E-06

Inside the Vessel	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	9.67E-12	7.43E-08	1.89E-08	1.56E-07	8.96E-08	2.77E-07	5.40E-08	0.00E+00	7.51E-07	4.09E-07
Water concentration (mg/L)	4.45E-11	3.57E-07	3.02E-08	5.02E-07	7.90E-07	7.68E-08	4.85E-08	0.00E+00	1.09E-10	4.88E-12
Suspended solids concentration (mg/kg)	3.07E-08	6.11E-04	1.91E-04	3.39E-03	1.02E-02	1.39E-02	1.59E-02	0.00E+00	1.51E-04	6.38E-05
Dissolved organic carbon (mg/kg)	9.80E-08	4.54E-03	7.41E-04	3.10E-02	2.57E-01	5.38E-02	5.56E-02	0.00E+00	1.81E-03	1.45E-03

Sediment Bed	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	3.70E-14	2.84E-10	7.24E-11	5.98E-10	3.43E-10	1.06E-09	2.07E-10	0.00E+00	2.87E-09	1.56E-09
Pore Water concentration (mg/L)	1.70E-13	1.36E-09	1.15E-10	1.92E-09	3.02E-09	2.94E-10	1.85E-10	0.00E+00	4.17E-13	1.87E-14
Sediment concentration (mg/kg)	7.84E-12	1.56E-07	4.87E-08	8.65E-07	2.60E-06	3.53E-06	4.06E-06	0.00E+00	3.85E-08	1.63E-08

Bioenergetic Inputs	Species	Body Weight	Lipid	Moisture	Caloric Density	GE to ME	Met Energy	Caloric Density	Production	Respiration	Excretion	Caloric Density	Met Energy
		(kg)	(%-dw)	(%)	(kcal/g-dry weight)	Fraction	(kcal/kg-lipid)	(kcal/kg-lipid)	(% of total)	(% of total)	(% of total)	(kcal/g-wt weight)	(kcal/g-wt weight)
Pelagic Community													
Phytoplankton (TL-I)	Algae		10%	84%	2.36	0.6	13748	22913				0.3776	0.22656
Zooplankton (TL-II)	copepods	0.000005	22%	76%	3.6	0.65	10636	16364	18%	24%	58%	0.864	0.5616
Planktivore (TL-III)	herring	0.05	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	1.225	0.8575
Piscivore (TL-IV)	jack	0.5	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	1.225	0.8575
Reef / Vessel Community													
Attached Algae (TL-I)	Algae		10%	84%	2.36	0.6	13748	22913				0.3776	0.22656
Sessile filter feeder (TL-II)	bivalves (w/o shell)	0.05	5%	82%	4.6	0.65	59800	92000	28%	31%	41%	0.828	0.5382
Invertebrate Omnivore (TL-II)	urchin	0.05	29%	82%	4.6	0.65	10310	15862	7%	25%	68%	0.828	0.5382
Invertebrate Forager (TL-III)	crab	1	9%	74%	2.7	0.65	19118	29412	28%	59%	13%	0.702	0.4563
Vertebrate Forager (TL-III)	triggerfish	1	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	1.225	0.8575
Predator (TL-IV)	grouper	1.5	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	0.2	0.14
Benthic Community													
Infaunal invert. (TL-II)	polychaete	0.01	6%	84%	4.6	0.65	50000	76923	71%	26%	3%	0.736	0.4784
Epifaunal invert. (TL-II)	nematode	0.01	6%	82%	4.6	0.65	50000	76923	31%	19%	50%	0.828	0.5382
Forager (TL-III)	lobster	2	9%	74%	2.7	0.65	19118	29412	28%	59%	13%	0.702	0.4563
Predator (TL-IV)	flounder	3	22%	75%	4.9	0.7	15591	22273	20%	60%	20%	1.225	0.8575

Bioenergetic Inputs		Respiration Rate Allometric Regression Parameters			Resp. Rate	Resp. Rate	Consumption	Growth Rate	Consumption	Consumption	
		a	b1	b2	1/day	gO2/kg-lipid-day	kcal/kg-lipid-day	1/day	g-wt weight/g-wt weight-d	kcal/-wet weight-da	As a % of body weight
Pelagic Community											
Phytoplankton (TL1)	Algae										
Zooplankton (TL-II)	copepods	0.006375522	0	0.039935335	0.015425453	84.24400867	1286.168071	0.014147849	0.32636028	0.06790967	32.6%
Planktivore (TL-III)	herring	0.0033	-0.227	0.0548	0.004949927	21.1649	129.2512977	0.001482433	0.01616792	0.0090799	1.6%
Piscivore (TL-IV)	jack	0.001118602	-0.55	0.12	0.000630951	2.697821256	16.47524431	0.000188961	0.00139796	0.00115739	0.1%
Reef / Vessel Community											
Attached Algae	Algae										
Sessile filter feeder (TL-II)	bivalves (w/o shell)	0.012	0	0.036	0.024213411	581.8482643	6877.300342	0.020930914	0.24377539	0.0618957	24.4%
Invertibrate Omnivore (TL-II)	urchin	0.000675466	0	0.079181846	0.003163548	13.1069075	192.1012396	0.000847751	0.03471132	0.01002768	3.5%
Invertibrate Forager (TL-III)	crab	0.001158234	0	0.071193202	0.004642088	60.75673491	377.3221989	0.003592107	0.01678102	0.00900593	1.7%
Vertibrate Forager (TL-III)	triggerfish	0.015181024	-0.415	0.061	0.002837229	12.13142452	74.08503521	0.00084971	0.00907693	0.00520447	0.9%
Predator (TL-IV)	grouper	0.00279	-0.355	0.0811	0.001011362	4.324384181	26.40845301	0.000302889	0.00264734	0.00185519	0.3%
Benthic Community											
Infaunal invert. (TL-II)	polychaete	0.001682129	0	0.071034762	0.006721006	135.0382801	1903.064429	0.017565285	0.09800757	0.01820852	9.8%
Epifaunal invert. (TL-II)	nematode	0.001682129	0	0.071034762	0.006721006	135.0382801	2604.19343	0.0104949	0.09262416	0.02803154	9.3%
Forager (TL-III)	lobster	0.0035	-0.13	0.066	0.00471923	61.76639253	383.5925529	0.003651801	0.01899736	0.00915559	1.9%
Predator (TL-IV)	flounder	0.0046	-0.24	0.067	0.002486878	13.58174479	82.94195291	0.000744785	0.00974341	0.00456181	1.0%

Dietary Preferences	Suspended Solids (Epilimnion)	Suspended Solids (Hypolimnion)	Sediment	Phytoplankton	Zooplankton	Pelagic Plankitivore	Attached Algae	Reef Sessile Filter Feeder	Invertebrate Omnivore	Reef Invertebrate Forager	Reef Vertebrate Forager	Infaunal Benthos	Epifaunal Benthos	Benthic Forager
Pelagic Community														
Phytoplankton (TL1)														
Zooplankton (TL-II)	15%	15%		70%										
Planktivore (TL-III)					100%									
Piscivore (TL-IV)					10%	90%								
Reef / Vessel Community														
Attached Algae														
Sessile filter feeder (TL-II)		10%		80%	10%									
Invertebrate Omnivore (TL-II)							80%	20%						
Invertebrate Forager (TL-III)		5%			5%	5%		35%	50%					
Vertebrate Forager (TL-III)						19%		19%	15%	22%		12.5%	12.5%	
Predator (TL-IV)										15%	60%	8%	8%	8%
Benthic Community														
Infaunal invert. (TL-II)			50%	30%	20%									
Epifaunal invert. (TL-II)			25%	30%	20%							25%		
Forager (TL-III)			5%									50%	45%	
Predator (TL-IV)			2%									20%	20%	58%

Water Exposures		Upper Water Column	Lower Water Column	Vessel Interior	Sediment Pore Water
Pelagic Community					
Phytoplankton (TL1)	Algae	100%			
Zooplankton (TL-II)	copepods	50%	50%		
Planktivore (TL-III)	herring	80%	20%		
Piscivore (TL-IV)	jack	80%	20%		
Reef / Vessel Community					
Attached Algae	Algae		100%		
Sessile filter feeder (TL-II)	bivalves (w/o shell)		100%		
Invertebrate Omnivore (TL-II)	urchin		80%	20%	
Invertebrate Forager (TL-III)	crab		70%	30%	
Vertebrate Forager (TL-III)	triggerfish		70%	30%	
Predator (TL-IV)	grouper		80%	20%	
Benthic Community					
Infaunal invert. (TL-II)	polychaete		20%		80%
Epifaunal invert. (TL-II)	nematode		50%		50%
Forager (TL-III)	lobster		75%		25%
Predator (TL-IV)	flounder		90%		10%

Energy Estimates for Suspended Sediment and Bedded Sediment	GE	ME	ME	as kcal/g-ww
Sediment (kcal/kg-oc)	11456	6873.6	0.6	0.01099776
Suspended Sediment (kcal/kg-oc)	11456	6873.6	0.6	0.1649664

Respiratory Efficiencies	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Low body weight (<100g)	4.335E-01	8.000E-01	8.000E-01	8.000E-01	4.492E-01	2.582E-01	2.018E-01	1.127E-01	5.303E-02	1.255E-02
High body weight (>100g)	5.000E-01	5.000E-01	5.000E-01	5.000E-01	3.769E-01	2.857E-01	2.526E-01	1.888E-01	1.295E-01	6.299E-02
Dietary Assimilation Efficiencies	27%	46%	53%	62%	69%	69%	68%	59%	44%	16%

Tissue Conc. (mg/kg-lipid)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Pelagic Community										
Phytoplankton (TL1)	1.017E-12	2.694E-08	2.167E-09	3.514E-08	4.615E-08	1.845E-09	7.559E-10	0.000E+00	3.406E-13	1.219E-15
Zooplankton (TL-II)	1.146E-08	4.254E-04	4.292E-05	8.101E-04	8.034E-04	1.150E-04	1.023E-04	0.000E+00	5.128E-07	7.581E-08
Planktivore (TL-III)	2.589E-09	3.603E-04	6.569E-05	2.403E-03	4.282E-03	6.738E-04	5.846E-04	0.000E+00	1.934E-06	1.018E-07
Piscivore (TL-IV)	6.768E-10	6.350E-05	1.744E-05	1.403E-03	7.505E-03	2.021E-03	1.976E-03	0.000E+00	5.773E-06	1.259E-07
Reef / Vessel Community										
Attached Algae	5.066E-09	1.364E-04	1.154E-05	1.918E-04	3.020E-04	2.938E-05	1.855E-05	0.000E+00	4.173E-08	1.866E-09
Sessile filter feeder (TL-II)	1.631E-07	5.502E-03	5.434E-04	1.022E-02	9.893E-03	8.762E-04	6.344E-04	0.000E+00	2.031E-06	2.204E-07
Invertebrate Omnivore (TL-II)	2.918E-07	2.276E-02	3.368E-03	1.086E-01	1.760E-01	1.254E-02	6.618E-03	0.000E+00	4.840E-06	7.177E-08
Invertebrate Forager (TL-III)	2.200E-06	9.016E-02	1.346E-02	4.556E-01	8.720E-01	6.930E-02	3.861E-02	0.000E+00	4.273E-05	2.740E-06
Vertebrate Forager (TL-III)	2.023E-07	1.430E-02	3.082E-03	1.811E-01	6.449E-01	6.567E-02	3.856E-02	0.000E+00	4.352E-05	1.408E-06
Predator (TL-IV)	1.122E-07	7.313E-03	1.732E-03	1.518E-01	1.174E+00	1.808E-01	1.165E-01	0.000E+00	1.254E-04	2.713E-06
Benthic Community										
Infaunal invert. (TL-II)	4.132E-08	1.623E-03	1.687E-04	3.337E-03	3.350E-03	3.066E-04	2.241E-04	0.000E+00	6.254E-07	4.457E-08
Epifaunal invert. (TL-II)	5.125E-08	3.018E-03	3.600E-04	8.148E-03	8.978E-03	8.606E-04	6.353E-04	0.000E+00	1.596E-06	8.752E-08
Forager (TL-III)	2.992E-08	1.653E-03	2.527E-04	7.636E-03	1.138E-02	1.064E-03	7.249E-04	0.000E+00	1.156E-06	2.651E-08
Predator (TL-IV)	2.649E-09	4.406E-04	1.161E-04	7.193E-03	2.167E-02	2.608E-03	1.841E-03	0.000E+00	2.367E-06	3.480E-08

Tissue Conc. (mg/kg-WW)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca	Total PCB
Pelagic Community											
Phytoplankton (TL1)	1.676E-14	4.439E-10	3.571E-11	5.792E-10	7.606E-10	3.041E-11	1.246E-11	0.000E+00	5.612E-15	2.010E-17	1.862E-09
Zooplankton (TL-II)	6.050E-10	2.246E-05	2.266E-06	4.277E-05	4.242E-05	6.070E-06	5.400E-06	0.000E+00	2.708E-08	4.003E-09	1.214E-04
Planktivore (TL-III)	1.819E-10	2.531E-05	4.615E-06	1.688E-04	3.008E-04	4.733E-05	4.107E-05	0.000E+00	1.359E-07	7.152E-09	5.880E-04
Piscivore (TL-IV)	4.755E-11	4.461E-06	1.225E-06	9.859E-05	5.272E-04	1.420E-04	1.388E-04	0.000E+00	4.055E-07	8.845E-09	9.127E-04
Reef / Vessel Community											
Attached Algae	8.350E-11	2.248E-06	1.902E-07	3.161E-06	4.977E-06	4.841E-07	3.057E-07	0.000E+00	6.876E-10	3.074E-11	1.137E-05
Sessile filter feeder (TL-II)	1.468E-09	4.952E-05	4.891E-06	9.197E-05	8.903E-05	7.886E-06	5.710E-06	0.000E+00	1.828E-08	1.983E-09	2.490E-04
Invertebrate Omnivore (TL-II)	1.523E-08	1.188E-03	1.758E-04	5.668E-03	9.186E-03	6.545E-04	3.455E-04	0.000E+00	2.527E-07	3.746E-09	1.722E-02
Invertebrate Forager (TL-III)	5.250E-08	2.152E-03	3.213E-04	1.087E-02	2.081E-02	1.654E-03	9.215E-04	0.000E+00	1.020E-06	6.540E-08	3.674E-02
Vertebrate Forager (TL-III)	1.421E-08	1.004E-03	2.165E-04	1.272E-02	4.530E-02	4.613E-03	2.709E-03	0.000E+00	3.057E-06	9.893E-08	6.657E-02
Predator (TL-IV)	7.885E-09	5.138E-04	1.217E-04	1.066E-02	8.247E-02	1.270E-02	8.181E-03	0.000E+00	8.810E-06	1.906E-07	1.147E-01
Benthic Community											
Infaunal invert. (TL-II)	3.954E-10	1.553E-05	1.614E-06	3.193E-05	3.205E-05	2.934E-06	2.144E-06	0.000E+00	5.984E-09	4.264E-10	8.621E-05
Epifaunal invert. (TL-II)	5.517E-10	3.249E-05	3.875E-06	8.770E-05	9.664E-05	9.264E-06	6.838E-06	0.000E+00	1.718E-08	9.420E-10	2.368E-04
Forager (TL-III)	7.142E-10	3.944E-05	6.031E-06	1.823E-04	2.716E-04	2.539E-05	1.730E-05	0.000E+00	2.758E-08	6.328E-10	5.421E-04
Predator (TL-IV)	1.457E-10	2.423E-05	6.388E-06	3.956E-04	1.192E-03	1.434E-04	1.013E-04	0.000E+00	1.302E-07	1.914E-09	1.863E-03

BAFs (L/kg-lipid)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Pelagic Community										
Phytoplankton (TL1)	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Zooplankton (TL-II)	1.347E+05	6.237E+05	7.436E+05	8.445E+05	5.319E+05	7.826E+05	1.103E+06	0.000E+00	2.458E+06	8.127E+06
Planktivore (TL-III)	7.604E+04	1.320E+06	2.844E+06	6.259E+06	7.084E+06	1.147E+07	1.576E+07	0.000E+00	2.317E+07	2.729E+07
Piscivore (TL-IV)	1.988E+04	2.326E+05	7.549E+05	3.656E+06	1.242E+07	3.439E+07	5.326E+07	0.000E+00	6.917E+07	3.375E+07
Reef / Vessel Community										
Attached Algae	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Sessile filter feeder (TL-II)	9.590E+05	4.034E+06	4.709E+06	5.328E+06	3.275E+06	2.983E+06	3.420E+06	0.000E+00	4.867E+06	1.181E+07
Invertebrate Omnivore (TL-II)	3.231E+04	3.143E+05	5.495E+05	1.066E+06	1.097E+06	8.039E+05	6.721E+05	0.000E+00	2.185E+05	7.246E+04
Invertebrate Forager (TL-III)	1.634E+05	8.353E+05	1.474E+06	3.001E+06	3.648E+06	2.981E+06	2.630E+06	0.000E+00	1.294E+06	1.856E+06
Vertebrate Forager (TL-III)	1.502E+04	1.324E+05	3.373E+05	1.193E+06	2.698E+06	2.825E+06	2.627E+06	0.000E+00	1.318E+06	9.538E+05
Predator (TL-IV)	1.243E+04	1.010E+05	2.827E+05	1.490E+06	7.321E+06	1.159E+07	1.183E+07	0.000E+00	5.661E+06	2.739E+06
Benthic Community										
Infaunal invert. (TL-II)	2.429E+05	1.190E+06	1.462E+06	1.740E+06	1.109E+06	1.044E+06	1.208E+06	0.000E+00	1.499E+06	2.389E+06
Epifaunal invert. (TL-II)	3.013E+05	2.213E+06	3.119E+06	4.248E+06	2.973E+06	2.930E+06	3.425E+06	0.000E+00	3.825E+06	4.691E+06
Forager (TL-III)	1.759E+05	1.212E+06	2.189E+06	3.981E+06	3.768E+06	3.622E+06	3.908E+06	0.000E+00	2.770E+06	1.421E+06
Predator (TL-IV)	1.557E+04	3.231E+05	1.006E+06	3.750E+06	7.176E+06	8.877E+06	9.928E+06	0.000E+00	5.673E+06	1.865E+06

Notes:
Kow = octanol to water partitioning coefficient, Koc = organic carbon partitioning coefficient, Kdoc = dissolved organic carbon partitioning coefficient
TL = trophic level, ww = wet weight

PCB MODELING RESULTS - PROSPECTIVE RISK EVALUATION

RISK ESTIMATES FOR Ex-Oriskany CV34

ZOI = 1	Cancer Risk Adult & Child		Hazard Adult & Child		Cancer Risk Child		Hazard Child	
RISK ESTIMATES	RME	CTE	RME	CTE	RME	CTE	RME	CTE
Benthic fish (flounder)	1.15E-07	8.88E-09	6.69E-03	1.53E-03	3.36E-08	6.82E-09	9.81E-03	1.77E-03
Benthic shellfish (lobster)	3.33E-08	2.58E-09	1.95E-03	4.46E-04	9.79E-09	1.98E-09	2.85E-03	5.15E-04
Pelagic fish (jack)	5.61E-08	4.35E-09	3.28E-03	7.51E-04	1.65E-08	3.34E-09	4.81E-03	8.66E-04
Reef fish TL-IV (grouper)	7.05E-06	5.46E-07	4.11E-01	9.44E-02	2.07E-06	4.20E-07	6.04E-01	1.09E-01
Reef fish TL-III (triggerfish)	4.10E-06	3.17E-07	2.39E-01	5.48E-02	1.20E-06	2.44E-07	3.51E-01	6.32E-02
Reef shellfish (crab)	2.26E-06	1.75E-07	1.32E-01	3.02E-02	6.63E-07	1.35E-07	1.93E-01	3.49E-02

PREDICTED EXPOSURE CONCENTRATIONS (mg/kg in fresh weight)	
Benthic fish (flounder)	1.86E-03
Benthic shellfish (lobster)	5.42E-04
Pelagic fish (jack)	9.13E-04
Reef fish TL-IV (grouper)	1.15E-01
Reef fish TL-III (triggerfish)	6.66E-02
Reef shellfish (crab)	3.67E-02

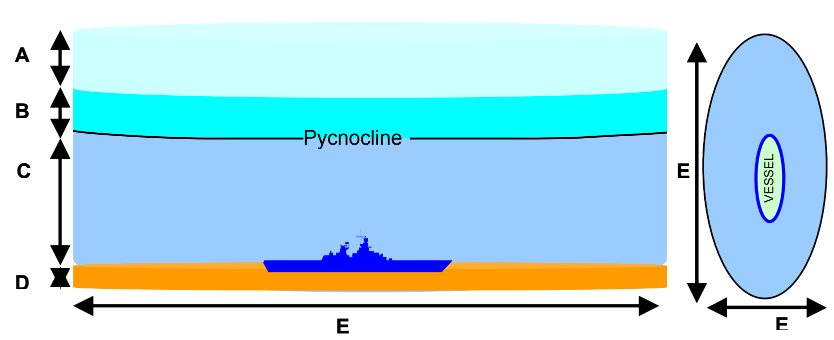
RISK INPUTS - Adult	RME	CTE
Body Weight (BWc) (kg)	70	70
Ingestion Rate (IRc) (kg/day)	0.0261	0.0072
Exposure Duration (EDc) (years)	24	3
Exposure Frequency (EFc) (days)	365	365
Averaging Time for cancer (ATc)	25550	25550
Slope Factor (mg/kg-day)	2	1
Reference dose for PCBs (RfD) (mg/kg-day)	0.00002	0.000045
Averaging Time for noncancer (ATnc-child)	8.76E+03	1.10E+03
Fractional Ingestion factor (FI)	0.17	0.25

RISK INPUTS - Child	RME	CTE
Body Weight (BWc) (kg)	15	15
Ingestion Rate (IRc) (kg/day)	0.0092916	0.0025632
Exposure Duration (EDc) (years)	6	6
Exposure Frequency (EFc) (days)	365	365
Averaging Time for cancer (ATc)	25550	25550
Slope Factor (mg/kg-day)	2	1
Reference dose for PCBs (RfD) (mg/kg-day)	0.00002	0.000045
Averaging Time for noncancer (ATnc-child)	2.19E+03	2.19E+03
Fractional Ingestion factor (FI)	0.17	0.25
Child - Adult IR scaling factor	0.356	

Zone of Influence Multiplier	1
Scenario run on	5/31/05 14:31

PCB-LADEN MATERIAL INPUTS	Fraction PCB	Release Rate (ng/g-d)	kg Material Onboard	PCB Release (ng/day)
Ventilation Gaskets	3.14E-05	1.58E+03	1.46E+03	7.23E+04
Lubricants	1.03E-04	2.20E+03	0.00E+00	0.00E+00
Foam Rubber Material	0.76%	2.62E+00	0.00E+00	0.00E+00
Black Rubber Material	5.29E-05	1.58E+03	5.40E+03	4.50E+05
Electrical Cable	1.85E-03	2.79E+02	2.96E+05	1.53E+08
Bulkhead Insulation Material	5.37E-04	6.76E+04	1.44E+04	5.22E+08
Aluminum Paint	2.00E-05	1.11E+04	3.87E+05	8.62E+07
Total				7.62E+08

Ex-Oriskany CV34	
Ex-Oriskany CV34	27100
Length (ft)	888
Beam (ft)	120



ZOI =	1	
Spatial Footprint on Ocean Floor		
	7.78E+03	m2
	3.00E-03	mile2
Modeled Dimensions Outside the Vessel		
A	1.00E+01	m
B	1.50E+01	m
C	5.00E+01	m
D	1.00E-01	m
E	2.71E+02	m
F	3.66E+01	m
Volumes		
Air Column		
Air	7.78E+04	m3
Upper Water Column		
Water	1.17E+05	m3
TSS	7.78E-01	m3
Lower Water Column		
Water	3.35E+05	m3
TSS	2.23E+00	m3
Inside Vessel		
Water	5.38E+04	m3
TSS	3.59E-01	m3
Sediment Bed		
Sediment	0.00E+00	m3

Abiotic Inputs	
Air Column	
Active air space height above water column (m)	10
Air current (m/h)	13677
Upper Water Column	
Temperature (oC)	24.5
Water depth (m)	15
Total suspended solids (mg/L)	10
Dissolved organic carbon (mg/L)	0.6
Dissolved oxygen (mg/L)	6.12
Lower Water Column	
Temperature (oC)	19.5
Water depth (m)	50
Total suspended solids (mg/L)	10
Dissolved organic carbon (mg/L)	0.6
Dissolved oxygen (mg/L)	4.59
Inside Vessel	
Temperature (oC)	19.5
Total suspended solids (mg/L)	10
Dissolved organic carbon (mg/L)	0.6
Dissolved oxygen (mg/L)	4.59
Sediment Bed	
Sediment density (g/cm3)	1.5
Active sediment depth (m)	0.1
Sediment fraction organic carbon	0.01
All Regions	
Suspended solids density (g/cm3)	1.5
Suspended solids fraction organic carbon	0.15
Dissolved organic carbon density (g/cm3)	1
Water current - to out of the ZOI (m/h)	926
Water current - inside to outside the vessel (m/h)	9.26

Total PCB concentrations		
Air Column		
Air	5.26E-17	g/m3
Upper Water Column		
Freely dissolved in water	1.13E-12	mg/L
Suspended solids	1.48E-08	mg/kg
Dissolved organic carbon	1.98E-07	mg/kg
Lower Water Column		
Freely dissolved in water	6.90E-09	mg/L
Suspended solids	1.70E-04	mg/kg
Dissolved organic carbon	1.55E-03	mg/kg
Inside Vessel		
Freely dissolved in water	1.80E-06	mg/L
Suspended solids	4.44E-02	mg/kg
Dissolved organic carbon	4.06E-01	mg/kg
Sediment Bed		
Freely dissolved in pore water	6.90E-09	mg/L
Bedded sediment	1.13E-05	mg/kg
Dissolved organic carbon in pore water	1.55E-03	mg/kg

Total PCB concentrations in biota			**Percent Exposures**	
Pelagic Community			Upper WC	Lower WC
Phytoplankton (TL-I)	1.86E-09	mg/kg	100%	0%
Zooplankton (TL-II)	1.21E-04	mg/kg	50%	50%
Planktivore (TL-III)	5.88E-04	mg/kg	80%	20%
Piscivore (TL-IV)	9.13E-04	mg/kg	80%	20%
Reef / Vessel Community			Lower WC	Vessel Int.
Attached Algae (TL-I)	1.14E-05	mg/kg	100%	0%
Sessile filter feeder (TL-II)	2.49E-04	mg/kg	100%	0%
Invertebrate Omnivore (TL-III)	1.72E-02	mg/kg	80%	20%
Invertebrate Forager (TL-III)	3.67E-02	mg/kg	70%	30%
Vertebrate Forager (TL-III)	6.66E-02	mg/kg	70%	30%
Predator (TL-IV)	1.15E-01	mg/kg	80%	20%
Benthic Community			Lower WC	Pore Water
Infaunal invert. (TL-II)	8.62E-05	mg/kg	20%	80%
Epifaunal invert. (TL-II)	2.37E-04	mg/kg	50%	50%
Forager (TL-III)	5.42E-04	mg/kg	75%	25%
Predator (TL-IV)	1.86E-03	mg/kg	90%	10%

PCB MODELING RESULTS - PROSPECTIVE RISK EVALUATION
RISK ESTIMATES FOR Ex-Oriskany CV34
Supplemental Information

Scenario Run on 5/26/05 8:46 **ZOI=2**

PCB Homolog	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Molecular Weight (g/mol)	1.89E+02	2.23E+02	2.58E+02	2.92E+02	3.26E+02	3.61E+02	3.95E+02	4.30E+02	4.64E+02	4.99E+02
Solubility (mg/L)	2.91E+00	6.78E-01	8.14E-02	6.67E-02	2.61E-02	9.50E-04	2.30E-04	2.11E-08	4.02E-09	1.69E-10
Solubility (mol/m^3)	1.54E-02	3.04E-03	3.16E-04	2.28E-04	8.00E-05	2.63E-06	5.82E-07	4.91E-11	8.65E-12	3.38E-13
Vapor Pressure (Pa)	6.32E-01	1.41E-01	5.11E-02	2.08E-02	2.96E-03	3.43E-03	2.56E-04	8.65E-05	2.77E-05	1.41E-05
Henry's (Pa-m^3/mol)	4.10E+01	4.65E+01	1.62E+02	9.10E+01	3.70E+01	1.30E+03	4.40E+02	1.76E+06	3.20E+06	4.18E+07
$\log_{10}K_{ow}$ =	4.47	5.24	5.52	5.92	6.50	6.98	7.19	7.70	8.35	9.60
$\log_{10}K_{oc}$ =	3.66	4.06	4.63	4.65	4.94	6.08	6.34	6.46	6.97	7.94
$\log_{10}K_{doc}$ =	3.34	4.11	4.39	4.79	5.51	5.85	6.06	6.57	7.22	8.47
Chemical emission rate (g/day)	1.37E-05	1.12E-01	9.95E-03	1.69E-01	3.20E-01	7.57E-02	7.37E-02	0.00E+00	8.28E-04	4.62E-04
Chemical emission rate (mol/hr)	3.03E-09	2.09E-05	1.61E-06	2.42E-05	4.08E-05	8.74E-06	7.77E-06	0.00E+00	7.43E-08	3.86E-08
Biodegradation in sediment (1/hr)	0	0	0	0	0	0	0	0	0	0
Biodegradation in water (1/hr)	0	0	0	0	0	0	0	0	0	0

	Ventilation Gaskets	Lubricants	Foam Rubber Material	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint
Fraction PCB in Material (wt/wt)	0.0000314	0.000103	0.76%	0.0000529	0.00185	0.000537	0.00002
Material Mass Onboard (kg)	1459	0	0	5397	296419	14379	386528
Total PCBs (kg)	0.0458126	0	0	0.2855013	548.37515	7.721523	7.73056
Total PCB Release rate (ng/g-PCB per day)	1.58E+03	2.20E+03	2.62E+00	1.58E+03	2.79E+02	6.76E+04	1.11E+04

Release Rates in nanograms PCB per gram of PCB within the Material	Ventilation Gaskets	Lubricants	Foam Rubber Material	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint
Monochlorobiphenyl	4.14E+01	3.47E+01	0.00E+00	4.14E+01	0.00E+00	0.00E+00	0.00E+00
Dichlorobiphenyl	1.27E+03	1.72E+02	3.08E-02	1.27E+03	2.03E+02	5.36E+00	0.00E+00
Trichlorobiphenyl	5.66E+01	8.97E+01	7.63E-02	5.66E+01	1.14E+00	9.44E+02	2.61E+02
Tetrachlorobiphenyl	1.44E+02	1.08E+03	1.29E+00	1.44E+02	1.57E+01	2.07E+04	1.23E+02
Pentachlorobiphenyl	6.31E+01	6.60E+02	3.90E-02	6.31E+01	1.80E+01	3.79E+04	2.24E+03
Hexachlorobiphenyl	0.00E+00	9.42E+01	5.34E-01	0.00E+00	2.41E+01	6.76E+03	1.33E+03
Heptachlorobiphenyl	5.04E+00	7.17E+01	6.46E-01	5.04E+00	1.47E+01	1.30E+03	7.19E+03
Octachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nonachlorobiphenyl	0.00E+00	0.00E+00	1.72E-03	0.00E+00	1.51E+00	0.00E+00	0.00E+00
Decachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.43E-01	0.00E+00	0.00E+00
Total	**1.58E+03**	**2.20E+03**	**2.62E+00**	**1.58E+03**	**2.79E+02**	**6.76E+04**	**1.11E+04**

Release Rates in nanograms PCB per Day	Ventilation Gaskets	Lubricants	Foam Rubber Material	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint	Total
Monochlorobiphenyl	1.90E+03	0.00E+00	0.00E+00	1.18E+04	0.00E+00	0.00E+00	0.00E+00	1.37E+04
Dichlorobiphenyl	5.80E+04	0.00E+00	0.00E+00	3.62E+05	1.11E+08	4.14E+04	0.00E+00	1.12E+08
Trichlorobiphenyl	2.59E+03	0.00E+00	0.00E+00	1.62E+04	6.25E+05	7.29E+06	2.02E+06	9.95E+06
Tetrachlorobiphenyl	6.60E+03	0.00E+00	0.00E+00	4.11E+04	8.61E+06	1.60E+08	9.51E+05	1.69E+08
Pentachlorobiphenyl	2.89E+03	0.00E+00	0.00E+00	1.80E+04	9.87E+06	2.93E+08	1.73E+07	3.20E+08
Hexachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E+07	5.22E+07	1.03E+07	7.57E+07
Heptachlorobiphenyl	2.31E+02	0.00E+00	0.00E+00	1.44E+03	8.06E+06	1.01E+07	5.56E+07	7.37E+07
Octachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nonachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.28E+05	0.00E+00	0.00E+00	8.28E+05
Decachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.62E+05	0.00E+00	0.00E+00	4.62E+05
Total	7.23E+04	0.00E+00	0.00E+00	4.50E+05	1.53E+08	5.22E+08	8.62E+07	7.62E+08

Air	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	3.22E-20	1.98E-16	1.30E-17	1.74E-16	1.91E-16	6.72E-18	2.40E-18	0.00E+00	8.51E-22	2.74E-24
Air concentration (g/m3)	2.47E-21	1.80E-17	1.37E-18	2.07E-17	2.54E-17	9.88E-19	3.86E-19	0.00E+00	1.61E-22	5.56E-25

Upper Water Column	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	6.67E-18	5.04E-14	1.22E-14	9.85E-14	4.71E-14	5.99E-14	7.57E-15	0.00E+00	2.11E-14	9.20E-16
Water concentration (mg/L)	3.07E-17	2.42E-13	1.95E-14	3.16E-13	4.15E-13	1.66E-14	6.80E-15	0.00E+00	3.06E-18	1.10E-20
Suspended solids concentration (mg/kg)	2.12E-14	4.15E-10	1.23E-10	2.14E-09	5.36E-09	2.99E-09	2.23E-09	0.00E+00	4.24E-12	1.44E-13
Dissolved organic carbon (mg/kg)	6.77E-14	3.09E-09	4.79E-10	1.95E-08	1.35E-07	1.16E-08	7.79E-09	0.00E+00	5.09E-11	3.25E-12

Lower Water Column	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	2.35E-14	1.81E-10	4.61E-11	3.80E-10	2.18E-10	6.75E-10	1.31E-10	0.00E+00	1.83E-09	9.95E-10
Water concentration (mg/L)	1.08E-13	8.67E-10	7.34E-11	1.22E-09	1.92E-09	1.87E-10	1.18E-10	0.00E+00	2.65E-13	1.19E-14
Suspended solids concentration (mg/kg)	7.47E-11	1.48E-06	4.64E-07	8.25E-06	2.48E-05	3.37E-05	3.87E-05	0.00E+00	3.68E-07	1.55E-07
Dissolved organic carbon (mg/kg)	2.38E-10	1.11E-05	1.80E-06	7.54E-05	6.26E-04	1.31E-04	1.35E-04	0.00E+00	4.41E-06	3.52E-06

Inside the Vessel	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	9.67E-12	7.43E-08	1.89E-08	1.56E-07	8.96E-08	2.77E-07	5.40E-08	0.00E+00	7.51E-07	4.09E-07
Water concentration (mg/L)	4.45E-11	3.57E-07	3.02E-08	5.02E-07	7.90E-07	7.68E-08	4.85E-08	0.00E+00	1.09E-10	4.88E-12
Suspended solids concentration (mg/kg)	3.07E-08	6.11E-04	1.91E-04	3.39E-03	1.02E-02	1.39E-02	1.59E-02	0.00E+00	1.51E-04	6.38E-05
Dissolved organic carbon (mg/kg)	9.80E-08	4.54E-03	7.41E-04	3.10E-02	2.57E-01	5.38E-02	5.56E-02	0.00E+00	1.81E-03	1.45E-03

Sediment Bed	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	2.35E-14	1.81E-10	4.61E-11	3.80E-10	2.18E-10	6.75E-10	1.31E-10	0.00E+00	1.83E-09	9.95E-10
Pore Water concentration (mg/L)	1.08E-13	8.67E-10	7.34E-11	1.22E-09	1.92E-09	1.87E-10	1.18E-10	0.00E+00	2.65E-13	1.19E-14
Sediment concentration (mg/kg)	4.98E-12	9.90E-08	3.09E-08	5.50E-07	1.65E-06	2.25E-06	2.58E-06	0.00E+00	2.45E-08	1.03E-08

Bioenergetic Inputs	Species	Body Weight	Lipid	Moisture	Caloric Density	GE to ME	Met Energy	Caloric Density	Production	Respiration	Excretion	Caloric Density	Met Energy
		(kg)	(%-dw)	(%)	(kcal/g-dry weight)	Fraction	(kcal/kg-lipid)	(kcal/kg-lipid)	(% of total)	(% of total)	(% of total)	(kcal/g-wt weight)	(kcal/g-wt weight)
Pelagic Community													
Phytoplankton (TL-I)	Algae		10%	84%	2.36	0.6	13748	22913				0.3776	0.22656
Zooplankton (TL-II)	copepods	0.000005	22%	76%	3.6	0.65	10636	16364	18%	24%	58%	0.864	0.5616
Planktivore (TL-III)	herring	0.05	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	1.225	0.8575
Piscivore (TL-IV)	jack	0.5	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	1.225	0.8575
Reef / Vessel Community													
Attached Algae (TL-I)	Algae		10%	84%	2.36	0.6	13748	22913				0.3776	0.22656
Sessile filter feeder (TL-II)	bivalves (w/o shell)	0.05	5%	82%	4.6	0.65	59800	92000	28%	31%	41%	0.828	0.5382
Invertebrate Omnivore (TL-II)	urchin	0.05	29%	82%	4.6	0.65	10310	15862	7%	25%	68%	0.828	0.5382
Invertebrate Forager (TL-III)	crab	1	9%	74%	2.7	0.65	19118	29412	28%	59%	13%	0.702	0.4563
Vertebrate Forager (TL-III)	triggerfish	1	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	1.225	0.8575
Predator (TL-IV)	grouper	1.5	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	0.2	0.14
Benthic Community													
Infaunal invert. (TL-II)	polychaete	0.01	6%	84%	4.6	0.65	50000	76923	71%	26%	3%	0.736	0.4784
Epifaunal invert. (TL-II)	nematode	0.01	6%	82%	4.6	0.65	50000	76923	31%	19%	50%	0.828	0.5382
Forager (TL-III)	lobster	2	9%	74%	2.7	0.65	19118	29412	28%	59%	13%	0.702	0.4563
Predator (TL-IV)	flounder	3	22%	75%	4.9	0.7	15591	22273	20%	60%	20%	1.225	0.8575

Bioenergetic Inputs		Respiration Rate Allometric Regression Parameters			Resp. Rate	Resp. Rate	Consumption	Growth Rate	Consumption	Consumption	
		a	b1	b2	1 / day	gO2 / kg-lipid-day	kcal / kg-lipid-day	1 / day	g-wt weight / g-wt weight-d	kcal / wet weight-da	As a % of body weight
Pelagic Community											
Phytoplankton (TL1)	Algae										
Zooplankton (TL-II)	copepods	0.006375522	0	0.039935335	0.015425453	84.24400867	1286.168071	0.014147849	0.32636028	0.06790967	32.6%
Planktivore (TL-III)	herring	0.0033	-0.227	0.0548	0.004949927	21.1649	129.2512977	0.001482433	0.01616792	0.0090799	1.6%
Piscivore (TL-IV)	jack	0.001118602	-0.55	0.12	0.000630951	2.697821256	16.47524431	0.000188961	0.00139796	0.00115739	0.1%
Reef / Vessel Community											
Attached Algae	Algae										
Sessile filter feeder (TL-II)	bivalves (w/o shell)	0.012	0	0.036	0.024213411	581.8482643	6877.300342	0.020930914	0.24377539	0.0618957	24.4%
Invertibrate Omnivore (TL-II)	urchin	0.000675466	0	0.079181846	0.003163548	13.1069075	192.1012396	0.000847751	0.03471132	0.01002768	3.5%
Invertibrate Forager (TL-III)	crab	0.001158234	0	0.071193202	0.004642088	60.75673491	377.3221989	0.003592107	0.01678102	0.00900593	1.7%
Vertibrate Forager (TL-III)	triggerfish	0.015181024	-0.415	0.061	0.002837229	12.13142452	74.08503521	0.00084971	0.00907693	0.00520447	0.9%
Predator (TL-IV)	grouper	0.00279	-0.355	0.0811	0.001011362	4.324384181	26.40845301	0.000302889	0.00264734	0.00185519	0.3%
Benthic Community											
Infaunal invert. (TL-II)	polychaete	0.001682129	0	0.071034762	0.006721006	135.0382801	1903.064429	0.017565285	0.09800757	0.01820852	9.8%
Epifaunal invert. (TL-II)	nematode	0.001682129	0	0.071034762	0.006721006	135.0382801	2604.19343	0.0104949	0.09262416	0.02803154	9.3%
Forager (TL-III)	lobster	0.0035	-0.13	0.066	0.00471923	61.76639253	383.5925529	0.003651801	0.01899736	0.00915559	1.9%
Predator (TL-IV)	flounder	0.0046	-0.24	0.067	0.002486878	13.58174479	82.94195291	0.000744785	0.00974341	0.00456181	1.0%

	Suspended Solids (Epilimnion)	Suspended Solids (Hypolimnion)	Sediment	Phytoplankton	Zooplankton	Pelagic Plankitivore	Attached Algae	Reef Sessile Filter Feeder	Invertebrate Omnivore	Reef Invertebrate Forager	Reef Vertebrate Forager	Infaunal Benthos	Epifaunal Benthos	Benthic Forager
TROPHIC LEVEL BASED ON DIET	1.125	1.25	1.5	1	2.05625	3.05625	1	2.130625	2.226125	3.17690625	2.964776563	2.46125	2.7015625	3.521328125
Dietary Preferences														
Pelagic Community														
Phytoplankton (TL1)														
Zooplankton (TL-II)	15%	15%		70%										
Planktivore (TL-III)					100%									
Piscivore (TL-IV)					10%	90%								
Reef / Vessel Community														
Attached Algae														
Sessile filter feeder (TL-II)		10%		80%	10%									
Invertebrate Omnivore (TL-II)							80%	20%						
Invertebrate Forager (TL-III)		5%			5%	5%		35%	50%					
Vertebrate Forager (TL-III)						19%		19%	15%	22%		12.5%	12.5%	
Predator (TL-IV)										15%	60%	8%	8%	8%
Benthic Community														
Infaunal invert. (TL-II)			50%	30%	20%									
Epifaunal invert. (TL-II)			25%	30%	20%							25%		
Forager (TL-III)			5%									50%	45%	
Predator (TL-IV)			2%									20%	20%	58%

Water Exposures		Upper Water Column	Lower Water Column	Vessel Interior	Sediment Pore Water
Pelagic Community					
Phytoplankton (TL1)	Algae	100%			
Zooplankton (TL-II)	copepods	50%	50%		
Planktivore (TL-III)	herring	80%	20%		
Piscivore (TL-IV)	jack	80%	20%		
Reef / Vessel Community					
Attached Algae	Algae		100%		
Sessile filter feeder (TL-II)	bivalves (w/o shell)		100%		
Invertebrate Omnivore (TL-II)	urchin		80%	20%	
Invertebrate Forager (TL-III)	crab		70%	30%	
Vertebrate Forager (TL-III)	triggerfish		70%	30%	
Predator (TL-IV)	grouper		80%	20%	
Benthic Community					
Infaunal invert. (TL-II)	polychaete		20%		80%
Epifaunal invert. (TL-II)	nematode		50%		50%
Forager (TL-III)	lobster		75%		25%
Predator (TL-IV)	flounder		90%		10%

Energy Estimates for Suspended Sediment and Bedded Sediment	GE	ME	ME	as kcal/g-ww
Sediment (kcal/kg-oc)	11456	6873.6	0.6	0.01099776
Suspended Sediment (kcal/kg-oc)	11456	6873.6	0.6	0.1649664

Respiratory Efficiencies	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Low body weight (<100g)	4.335E-01	8.000E-01	8.000E-01	8.000E-01	4.492E-01	2.582E-01	2.018E-01	1.127E-01	5.303E-02	1.255E-02
High body weight (>100g)	5.000E-01	5.000E-01	5.000E-01	5.000E-01	3.769E-01	2.857E-01	2.526E-01	1.888E-01	1.295E-01	6.299E-02
Dietary Assimilation Efficiencies	27%	46%	53%	62%	69%	69%	68%	59%	44%	16%

Tissue Conc. (mg/kg-lipid)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Pelagic Community										
Phytoplankton (TL1)	9.143E-13	2.422E-08	1.948E-09	3.159E-08	4.150E-08	1.659E-09	6.797E-10	0.000E+00	3.062E-13	1.097E-15
Zooplankton (TL-II)	7.287E-09	2.706E-04	2.729E-05	5.151E-04	5.109E-04	7.310E-05	6.504E-05	0.000E+00	3.261E-07	4.821E-08
Planktivore (TL-III)	1.647E-09	2.291E-04	4.178E-05	1.528E-03	2.723E-03	4.285E-04	3.717E-04	0.000E+00	1.230E-06	6.474E-08
Piscivore (TL-IV)	4.305E-10	4.039E-05	1.109E-05	8.926E-04	4.773E-03	1.285E-03	1.257E-03	0.000E+00	3.671E-06	8.006E-08
Reef / Vessel Community										
Attached Algae	3.222E-09	8.672E-05	7.339E-06	1.220E-04	1.920E-04	1.868E-05	1.179E-05	0.000E+00	2.653E-08	1.186E-09
Sessile filter feeder (TL-II)	1.037E-07	3.499E-03	3.456E-04	6.498E-03	6.291E-03	5.571E-04	4.034E-04	0.000E+00	1.291E-06	1.401E-07
Invertebrate Omnivore (TL-II)	2.898E-07	2.252E-02	3.328E-03	1.071E-01	1.730E-01	1.224E-02	6.420E-03	0.000E+00	4.488E-06	6.064E-08
Invertebrate Forager (TL-III)	2.192E-06	8.951E-02	1.334E-02	4.503E-01	8.597E-01	6.798E-02	3.772E-02	0.000E+00	4.148E-05	2.711E-06
Vertebrate Forager (TL-III)	2.015E-07	1.416E-02	3.046E-03	1.785E-01	6.347E-01	6.428E-02	3.756E-02	0.000E+00	4.214E-05	1.385E-06
Predator (TL-IV)	1.116E-07	7.257E-03	1.715E-03	1.498E-01	1.156E+00	1.771E-01	1.137E-01	0.000E+00	1.222E-04	2.685E-06
Benthic Community										
Infaunal invert. (TL-II)	2.628E-08	1.032E-03	1.073E-04	2.122E-03	2.130E-03	1.950E-04	1.425E-04	0.000E+00	3.977E-07	2.834E-08
Epifaunal invert. (TL-II)	3.259E-08	1.919E-03	2.289E-04	5.181E-03	5.709E-03	5.472E-04	4.040E-04	0.000E+00	1.015E-06	5.565E-08
Forager (TL-III)	1.903E-08	1.051E-03	1.607E-04	4.856E-03	7.236E-03	6.765E-04	4.610E-04	0.000E+00	7.349E-07	1.686E-08
Predator (TL-IV)	1.685E-09	2.802E-04	7.385E-05	4.574E-03	1.378E-02	1.658E-03	1.171E-03	0.000E+00	1.505E-06	2.213E-08

Tissue Conc. (mg/kg-WW)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca	Total PCB
Pelagic Community											
Phytoplankton (TL1)	1.507E-14	3.991E-10	3.211E-11	5.207E-10	6.838E-10	2.735E-11	1.120E-11	0.000E+00	5.047E-15	1.807E-17	1.674E-09
Zooplankton (TL-II)	3.847E-10	1.429E-05	1.441E-06	2.720E-05	2.698E-05	3.860E-06	3.434E-06	0.000E+00	1.722E-08	2.545E-09	7.722E-05
Planktivore (TL-III)	1.157E-10	1.610E-05	2.935E-06	1.073E-04	1.913E-04	3.010E-05	2.611E-05	0.000E+00	8.639E-08	4.548E-09	3.740E-04
Piscivore (TL-IV)	3.024E-11	2.837E-06	7.791E-07	6.270E-05	3.353E-04	9.028E-05	8.828E-05	0.000E+00	2.579E-07	5.625E-09	5.804E-04
Reef / Vessel Community											
Attached Algae	5.309E-11	1.429E-06	1.209E-07	2.010E-06	3.165E-06	3.078E-07	1.944E-07	0.000E+00	4.372E-10	1.955E-11	7.228E-06
Sessile filter feeder (TL-II)	9.335E-10	3.149E-05	3.110E-06	5.848E-05	5.662E-05	5.014E-06	3.631E-06	0.000E+00	1.162E-08	1.261E-09	1.584E-04
Invertebrate Omnivore (TL-II)	1.513E-08	1.176E-03	1.737E-04	5.591E-03	9.032E-03	6.389E-04	3.351E-04	0.000E+00	2.343E-07	3.166E-09	1.695E-02
Invertebrate Forager (TL-III)	5.231E-08	2.136E-03	3.184E-04	1.075E-02	2.052E-02	1.623E-03	9.003E-04	0.000E+00	9.901E-07	6.469E-08	3.624E-02
Vertebrate Forager (TL-III)	1.415E-08	9.949E-04	2.140E-04	1.254E-02	4.459E-02	4.516E-03	2.638E-03	0.000E+00	2.960E-06	9.732E-08	6.550E-02
Predator (TL-IV)	7.841E-09	5.098E-04	1.205E-04	1.052E-02	8.122E-02	1.244E-02	7.984E-03	0.000E+00	8.585E-06	1.886E-07	1.128E-01
Benthic Community											
Infaunal invert. (TL-II)	2.514E-10	9.875E-06	1.026E-06	2.030E-05	2.038E-05	1.866E-06	1.363E-06	0.000E+00	3.805E-09	2.711E-10	5.482E-05
Epifaunal invert. (TL-II)	3.508E-10	2.066E-05	2.464E-06	5.577E-05	6.146E-05	5.891E-06	4.348E-06	0.000E+00	1.092E-08	5.990E-10	1.506E-04
Forager (TL-III)	4.541E-10	2.508E-05	3.835E-06	1.159E-04	1.727E-04	1.615E-05	1.100E-05	0.000E+00	1.754E-08	4.024E-10	3.447E-04
Predator (TL-IV)	9.265E-11	1.541E-05	4.062E-06	2.516E-04	7.580E-04	9.120E-05	6.440E-05	0.000E+00	8.279E-08	1.217E-09	1.185E-03

BAFs (L/kg-lipid)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Pelagic Community										
Phytoplankton (TL1)	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Zooplankton (TL-II)	1.347E+05	6.238E+05	7.436E+05	8.445E+05	5.320E+05	7.826E+05	1.103E+06	0.000E+00	2.458E+06	8.127E+06
Planktivore (TL-III)	7.603E+04	1.320E+06	2.843E+06	6.258E+06	7.083E+06	1.146E+07	1.576E+07	0.000E+00	2.317E+07	2.729E+07
Piscivore (TL-IV)	1.988E+04	2.326E+05	7.548E+05	3.655E+06	1.242E+07	3.439E+07	5.326E+07	0.000E+00	6.917E+07	3.375E+07
Reef / Vessel Community										
Attached Algae	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Sessile filter feeder (TL-II)	9.590E+05	4.034E+06	4.709E+06	5.328E+06	3.276E+06	2.983E+06	3.420E+06	0.000E+00	4.867E+06	1.181E+07
Invertebrate Omnivore (TL-II)	3.226E+04	3.127E+05	5.460E+05	1.057E+06	1.085E+06	7.891E+05	6.556E+05	0.000E+00	2.037E+05	6.157E+04
Invertebrate Forager (TL-III)	1.633E+05	8.319E+05	1.465E+06	2.976E+06	3.608E+06	2.934E+06	2.578E+06	0.000E+00	1.260E+06	1.842E+06
Vertebrate Forager (TL-III)	1.501E+04	1.316E+05	3.345E+05	1.180E+06	2.664E+06	2.774E+06	2.567E+06	0.000E+00	1.280E+06	9.414E+05
Predator (TL-IV)	1.243E+04	1.008E+05	2.815E+05	1.479E+06	7.250E+06	1.142E+07	1.161E+07	0.000E+00	5.547E+06	2.726E+06
Benthic Community										
Infaunal invert. (TL-II)	2.429E+05	1.190E+06	1.462E+06	1.740E+06	1.109E+06	1.044E+06	1.208E+06	0.000E+00	1.499E+06	2.389E+06
Epifaunal invert. (TL-II)	3.013E+05	2.213E+06	3.119E+06	4.248E+06	2.973E+06	2.930E+06	3.425E+06	0.000E+00	3.825E+06	4.691E+06
Forager (TL-III)	1.759E+05	1.212E+06	2.189E+06	3.981E+06	3.768E+06	3.622E+06	3.909E+06	0.000E+00	2.770E+06	1.421E+06
Predator (TL-IV)	1.557E+04	3.231E+05	1.006E+06	3.750E+06	7.177E+06	8.877E+06	9.928E+06	0.000E+00	5.673E+06	1.865E+06

Notes:
Kow = octanol to water partitioning coefficient, Koc = organic carbon partitioning coefficient, Kdoc = dissolved organic carbon partitioning coefficient
TL = trophic level, ww = wet weight

B MODELING RESULTS - PROSPECTIVE RISK EVALUATION

RISK ESTIMATES FOR Ex-Oriskany CV34

ZOI = 2	:er Risk Adult & (		Hazard Adult & Child		:ancer Risk Chil		Hazard Child	
RISK ESTIMATES	RME	CTE	RME	CTE	RME	CTE	RME	CTE
Benthic fish (flounder)	######	######	######	9.75E-04	######	######	6.24E-03	#######
Benthic shellfish (lobster)	######	######	######	2.84E-04	######	######	1.81E-03	#######
Pelagic fish (jack)	######	######	######	4.78E-04	######	######	3.06E-03	#######
Reef fish TL-IV (grouper)	######	######	######	9.29E-02	######	######	5.94E-01	#######
Reef fish TL-III (triggerfish)	######	######	######	5.39E-02	######	######	3.45E-01	#######
Reef shellfish (crab)	######	######	######	2.98E-02	######	######	1.91E-01	#######

PREDICTED EXPOSURE CONCENTRATIONS (mg/kg in fresh weight)	
Benthic fish (flounder)	######
Benthic shellfish (lobster)	######
Pelagic fish (jack)	######
Reef fish TL-IV (grouper)	######
Reef fish TL-III (triggerfish)	######
Reef shellfish (crab)	######

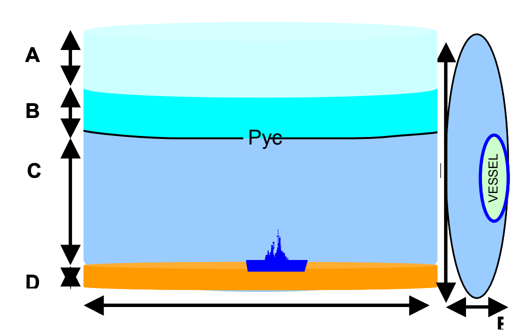
RISK INPUTS - Adult	RME	CTE
Body Weight (BWc) (kg)	70	70
Ingestion Rate (IRc) (kg/day)	0.0261	0.0072
Exposure Duration (EDc) (ye	24	3
Exposure Frequency (EFc) (c	365	365
Averaging Time for cancer (/	25550	25550
Slope Factor (mg/kg-day)	2	1
Reference dose for PCBs (Rf	2E-05	5E-05
Averaging Time for noncanc	######	######
Fractional Ingestion factor (F	0.17	0.25

RISK INPUTS - Child	RME	CTE
Body Weight (BWc) (kg)	15	15
Ingestion Rate (IRc) (kg/day)	0.00929	0.0026
Exposure Duration (EDc) (years)	6	6
Exposure Frequency (EFc) (days)	365	365
Averaging Time for cancer (ATc)	25550	25550
Slope Factor (mg/kg-day)	2	1
Reference dose for PCBs (RfD) (mg	0.00002	5E-05
Averaging Time for noncancer (ATı	#######	######
Fractional Ingestion factor (FI)	0.17	0.25
Child - Adult IR scaling factor	0.356	

Zone of Influence Multi	2
Scenario run on	5/26/05 8:46

PCB-LADEN MATERIAL I	Fraction PCB	Release :ate (ng/g-	g Materi: Onboard	:B Release (ng/day)
Ventilation Gaskets	######	######	######	######
Lubricants	######	######	######	######
Foam Rubber Material	0.76%	######	######	######
Black Rubber Material	######	######	######	######
Electrical Cable	######	######	######	######
Bulkhead Insulation Material	######	######	######	######
Aluminum Paint	######	######	######	######
Total				######

Ex-Oriskany CV34	
Ex-Oriskany CV34	27100
Length (ft)	888
Beam (ft)	120



ZOI =	2
tial Footprint on Ocean F	
#####	m2
#####	mile2
Modeled Dimensions Outside the Vessel	
A	###### m
B	###### m
C	##### m
D	###### m
E	###### m
F	###### m
Volumes	
Air Column	
Air	###### m3
Upper Water Column	
Water	###### m3
TSS	###### m3
Lower Water Column	
Water	###### m3
TSS	###### m3
Inside Vessel	
Water	##### m3
TSS	##### m3
Sediment Bed	
Sedimer	###### m3

Abiotic Inputs	
Air Column	
Active air space height above water	10
Air current (m/h)	13677
Upper Water Column	
Temperature (oC)	24.5
Water depth (m)	15
Total suspended solids (mg/L)	10
Dissolved organic carbon (mg/L)	0.6
Dissolved oxygen (mg/L)	6.12
Lower Water Column	
Temperature (oC)	19.5
Water depth (m)	50
Total suspended solids (mg/L)	10
Dissolved organic carbon (mg/L)	0.6
Dissolved oxygen (mg/L)	4.59
Inside Vessel	
Temperature (oC)	19.5
Total suspended solids (mg/L)	10
Dissolved organic carbon (mg/L)	0.6
Dissolved oxygen (mg/L)	4.59
Sediment Bed	
Sediment density (g/cm3)	1.5
Active sediment depth (m)	0.1
Sediment fraction organic carbon	0.01
All Regions	
Suspended solids density (g/cm3)	1.5
Suspended solids fraction organic c	0.15
Dissolved organic carbon density (g	1
Water current - to out of the ZOI (n	926
Water current - inside to outside the	9.26

Total PCB concentrations		
Air Column		
Air	#####	g/m3
Upper Water Column		
Freely dissolved in water	######	mg/L
Suspended solids	######	mg/kg
Dissolved organic carbon	######	mg/kg
Lower Water Column		
Freely dissolved in water	######	mg/L
Suspended solids	######	mg/kg
Dissolved organic carbon	######	mg/kg
Inside Vessel		
Freely dissolved in water	######	mg/L
Suspended solids	######	mg/kg
Dissolved organic carbon	#####	mg/kg
Sediment Bed		
Freely dissolved in pore w	#####	mg/L
Bedded sediment	######	mg/kg
Dissolved organic carbon i	#####	mg/kg

Total PCB concentrations in biota			**Percent Exposure**	
Pelagic Community			Upper W(	Lower W(
Phytoplankton (TL	######	mg/kg	100%	0%
Zooplankton (TL-I	######	mg/kg	50%	50%
Planktivore (TL-II	######	mg/kg	80%	20%
Piscivore (TL-IV)	######	mg/kg	80%	20%
Reef / Vessel Community			Lower W(	/essel Int
Attached Algae (T	######	mg/kg	100%	0%
Sessile filter feede	######	mg/kg	100%	0%
Invertebrate Omni	######	mg/kg	80%	20%
Invertebrate Forag	######	mg/kg	70%	30%
Vertebrate Forager	######	mg/kg	70%	30%
Predator (TL-IV)	######	mg/kg	80%	20%
Benthic Community			Lower W(	ore Wate
Infaunal invert. (T	######	mg/kg	20%	80%
Epifaunal invert. (	######	mg/kg	50%	50%
Forager (TL-III)	######	mg/kg	75%	25%
Predator (TL-IV)	#####	mg/kg	90%	10%

PCB MODELING RESULTS - PROSPECTIVE RISK EVALUATION

RISK ESTIMATES FOR Ex-Oriskany CV34

Supplemental Information

Scenario Run on 6/1/05 12:00 **ZOI = 3**

PCB Homolog	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Molecular Weight (g/mol)	1.89E+02	2.23E+02	2.58E+02	2.92E+02	3.26E+02	3.61E+02	3.95E+02	4.30E+02	4.64E+02	4.99E+02
Solubility (mg/L)	2.91E+00	6.78E-01	8.14E-02	6.67E-02	2.61E-02	9.50E-04	2.30E-04	2.11E-08	4.02E-09	1.69E-10
Solubility (mol/m^3)	1.54E-02	3.04E-03	3.16E-04	2.28E-04	8.00E-05	2.63E-06	5.82E-07	4.91E-11	8.65E-12	3.38E-13
Vapor Pressure (Pa)	6.32E-01	1.41E-01	5.11E-02	2.08E-02	2.96E-03	3.43E-03	2.56E-04	8.65E-05	2.77E-05	1.41E-05
Henry's (Pa-m^3/mol)	4.10E+01	4.65E+01	1.62E+02	9.10E+01	3.70E+01	1.30E+03	4.40E+02	1.76E+06	3.20E+06	4.18E+07
$\log_{10}K_{ow}$ =	4.47	5.24	5.52	5.92	6.50	6.98	7.19	7.70	8.35	9.60
$\log_{10}K_{oc}$ =	3.66	4.06	4.63	4.65	4.94	6.08	6.34	6.46	6.97	7.94
$\log_{10}K_{doc}$ =	3.34	4.11	4.39	4.79	5.51	5.85	6.06	6.57	7.22	8.47
Chemical emission rate (g/day)	1.37E-05	1.12E-01	9.95E-03	1.69E-01	3.20E-01	7.57E-02	7.37E-02	0.00E+00	8.28E-04	4.62E-04
Chemical emission rate (mol/hr)	3.03E-09	2.09E-05	1.61E-06	2.42E-05	4.08E-05	8.74E-06	7.77E-06	0.00E+00	7.43E-08	3.86E-08
Biodegradation in sediment (1/hr)	0	0	0	0	0	0	0	0	0	0
Biodegradation in water (1/hr)	0	0	0	0	0	0	0	0	0	0

	Ventilation Gaskets	Lubricants	Foam Rubber Material	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint
Fraction PCB in Material (wt/wt)	0.0000314	0.000103	0.76%	0.0000529	0.00185	0.000537	0.00002
Material Mass Onboard (kg)	1459	0	0	5397	296419	14379	386528
Total PCBs (kg)	0.0458126	0	0	0.2855013	548.37515	7.721523	7.73056
Total PCB Release rate (ng/g-PCB per day)	1.58E+03	2.20E+03	2.62E+00	1.58E+03	2.79E+02	6.76E+04	1.11E+04

Release Rates in nanograms PCB per gram of PCB within the Material	Ventilation Gaskets	Lubricants	Foam Rubber Material	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint
Monochlorobiphenyl	4.14E+01	3.47E+01	0.00E+00	4.14E+01	0.00E+00	0.00E+00	0.00E+00
Dichlorobiphenyl	1.27E+03	1.72E+02	3.08E-02	1.27E+03	2.03E+02	5.36E+00	0.00E+00
Trichlorobiphenyl	5.66E+01	8.97E+01	7.63E-02	5.66E+01	1.14E+00	9.44E+02	2.61E+02
Tetrachlorobiphenyl	1.44E+02	1.08E+03	1.29E+00	1.44E+02	1.57E+01	2.07E+04	1.23E+02
Pentachlorobiphenyl	6.31E+01	6.60E+02	3.90E-02	6.31E+01	1.80E+01	3.79E+04	2.24E+03
Hexachlorobiphenyl	0.00E+00	9.42E+01	5.34E-01	0.00E+00	2.41E+01	6.76E+03	1.33E+03
Heptachlorobiphenyl	5.04E+00	7.17E+01	6.46E-01	5.04E+00	1.47E+01	1.30E+03	7.19E+03
Octachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nonachlorobiphenyl	0.00E+00	0.00E+00	1.72E-03	0.00E+00	1.51E+00	0.00E+00	0.00E+00
Decachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.43E-01	0.00E+00	0.00E+00
Total	**1.58E+03**	**2.20E+03**	**2.62E+00**	**1.58E+03**	**2.79E+02**	**6.76E+04**	**1.11E+04**

Release Rates in nanograms PCB per Day	Ventilation Gaskets	Lubricants	Foam Rubber Material	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint	Total
Monochlorobiphenyl	1.90E+03	0.00E+00	0.00E+00	1.18E+04	0.00E+00	0.00E+00	0.00E+00	1.37E+04
Dichlorobiphenyl	5.80E+04	0.00E+00	0.00E+00	3.62E+05	1.11E+08	4.14E+04	0.00E+00	1.12E+08
Trichlorobiphenyl	2.59E+03	0.00E+00	0.00E+00	1.62E+04	6.25E+05	7.29E+06	2.02E+06	9.95E+06
Tetrachlorobiphenyl	6.60E+03	0.00E+00	0.00E+00	4.11E+04	8.61E+06	1.60E+08	9.51E+05	1.69E+08
Pentachlorobiphenyl	2.89E+03	0.00E+00	0.00E+00	1.80E+04	9.87E+06	2.93E+08	1.73E+07	3.20E+08
Hexachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E+07	5.22E+07	1.03E+07	7.57E+07
Heptachlorobiphenyl	2.31E+02	0.00E+00	0.00E+00	1.44E+03	8.06E+06	1.01E+07	5.56E+07	7.37E+07
Octachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nonachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.28E+05	0.00E+00	0.00E+00	8.28E+05
Decachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.62E+05	0.00E+00	0.00E+00	4.62E+05
Total	7.23E+04	0.00E+00	0.00E+00	4.50E+05	1.53E+08	5.22E+08	8.62E+07	7.62E+08

Air	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	3.77E-20	2.32E-16	1.53E-17	2.04E-16	2.24E-16	7.88E-18	2.81E-18	0.00E+00	9.97E-22	3.21E-24
Air concentration (g/m3)	2.89E-21	2.11E-17	1.60E-18	2.43E-17	2.97E-17	1.16E-18	4.52E-19	0.00E+00	1.89E-22	6.51E-25

Upper Water Column	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	6.39E-18	4.83E-14	1.17E-14	9.43E-14	4.51E-14	5.74E-14	7.25E-15	0.00E+00	2.02E-14	8.80E-16
Water concentration (mg/L)	2.94E-17	2.32E-13	1.86E-14	3.02E-13	3.97E-13	1.59E-14	6.51E-15	0.00E+00	2.93E-18	1.05E-20
Suspended solids concentration (mg/kg)	2.03E-14	3.97E-10	1.18E-10	2.05E-09	5.13E-09	2.86E-09	2.14E-09	0.00E+00	4.06E-12	1.37E-13
Dissolved organic carbon (mg/kg)	6.47E-14	2.95E-09	4.58E-10	1.87E-08	1.29E-07	1.11E-08	7.46E-09	0.00E+00	4.87E-11	3.11E-12

Lower Water Column	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	1.84E-14	1.41E-10	3.60E-11	2.97E-10	1.70E-10	5.27E-10	1.03E-10	0.00E+00	1.43E-09	7.78E-10
Water concentration (mg/L)	8.45E-14	6.78E-10	5.74E-11	9.53E-10	1.50E-09	1.46E-10	9.22E-11	0.00E+00	2.07E-13	9.27E-15
Suspended solids concentration (mg/kg)	5.84E-11	1.16E-06	3.63E-07	6.45E-06	1.94E-05	2.63E-05	3.03E-05	0.00E+00	2.87E-07	1.21E-07
Dissolved organic carbon (mg/kg)	1.86E-10	8.64E-06	1.41E-06	5.89E-05	4.89E-04	1.02E-04	1.06E-04	0.00E+00	3.44E-06	2.75E-06

Inside the Vessel	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	9.67E-12	7.43E-08	1.89E-08	1.56E-07	8.96E-08	2.77E-07	5.40E-08	0.00E+00	7.51E-07	4.09E-07
Water concentration (mg/L)	4.45E-11	3.57E-07	3.02E-08	5.02E-07	7.90E-07	7.68E-08	4.85E-08	0.00E+00	1.09E-10	4.88E-12
Suspended solids concentration (mg/kg)	3.07E-08	6.11E-04	1.91E-04	3.39E-03	1.02E-02	1.39E-02	1.59E-02	0.00E+00	1.51E-04	6.38E-05
Dissolved organic carbon (mg/kg)	9.80E-08	4.54E-03	7.41E-04	3.10E-02	2.57E-01	5.38E-02	5.56E-02	0.00E+00	1.81E-03	1.45E-03

Sediment Bed	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	1.84E-14	1.41E-10	3.60E-11	2.97E-10	1.70E-10	5.27E-10	1.03E-10	0.00E+00	1.43E-09	7.78E-10
Pore Water concentration (mg/L)	8.45E-14	6.78E-10	5.74E-11	9.53E-10	1.50E-09	1.46E-10	9.22E-11	0.00E+00	2.07E-13	9.27E-15
Sediment concentration (mg/kg)	3.89E-12	7.74E-08	2.42E-08	4.30E-07	1.29E-06	1.76E-06	2.02E-06	0.00E+00	1.92E-08	8.09E-09

Bioenergetic Inputs	Species	Body Weight	Lipid	Moisture	Caloric Density	GE to ME	Met Energy	Caloric Density	Production	Respiration	Excretion	Caloric Density	Met Energy
		(kg)	(%-dw)	(%)	(kcal/g-dry weight)	Fraction	(kcal/kg-lipid)	(kcal/kg-lipid)	(% of total)	(% of total)	(% of total)	(kcal/g-wt weight)	(kcal/g-wt weight)
Pelagic Community													
Phytoplankton (TL-I)	Algae		10%	84%	2.36	0.6	13748	22913				0.3776	0.22656
Zooplankton (TL-II)	copepods	0.000005	22%	76%	3.6	0.65	10636	16364	18%	24%	58%	0.864	0.5616
Planktivore (TL-III)	herring	0.05	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	1.225	0.8575
Piscivore (TL-IV)	jack	0.5	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	1.225	0.8575
Reef / Vessel Community													
Attached Algae (TL-I)	Algae		10%	84%	2.36	0.6	13748	22913				0.3776	0.22656
Sessile filter feeder (TL-II)	bivalves (w/o shell)	0.05	5%	82%	4.6	0.65	59800	92000	28%	31%	41%	0.828	0.5382
Invertebrate Omnivore (TL-II)	urchin	0.05	29%	82%	4.6	0.65	10310	15862	7%	25%	68%	0.828	0.5382
Invertebrate Forager (TL-III)	crab	1	9%	74%	2.7	0.65	19118	29412	28%	59%	13%	0.702	0.4563
Vertebrate Forager (TL-III)	triggerfish	1	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	1.225	0.8575
Predator (TL-IV)	grouper	1.5	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	0.2	0.14
Benthic Community													
Infaunal invert. (TL-II)	polychaete	0.01	6%	84%	4.6	0.65	50000	76923	71%	26%	3%	0.736	0.4784
Epifaunal invert. (TL-II)	nematode	0.01	6%	82%	4.6	0.65	50000	76923	31%	19%	50%	0.828	0.5382
Forager (TL-III)	lobster	2	9%	74%	2.7	0.65	19118	29412	28%	59%	13%	0.702	0.4563
Predator (TL-IV)	flounder	3	22%	75%	4.9	0.7	15591	22273	20%	60%	20%	1.225	0.8575

Bioenergetic Inputs		Respiration Rate Allometric Regression Parameters			Resp. Rate	Resp. Rate	Consumption	Growth Rate	Consumption	Consumption	
		a	b1	b2	1 / day	gO2 / kg-lipid-day	kcal / kg-lipid-day	1 / day	g-wt weight / g-wt weight-d	kcal / -wet weight-da	As a % of body weight
Pelagic Community											
Phytoplankton (TL1)	Algae										
Zooplankton (TL-II)	copepods	0.006375522	0	0.039935335	0.015425453	84.24400867	1286.168071	0.014147849	0.32636028	0.06790967	32.6%
Planktivore (TL-III)	herring	0.0033	-0.227	0.0548	0.004949927	21.1649	129.2512977	0.001482433	0.01616792	0.0090799	1.6%
Piscivore (TL-IV)	jack	0.001118602	-0.55	0.12	0.000630951	2.697821256	16.47524431	0.000188961	0.00139796	0.00115739	0.1%
Reef / Vessel Community											
Attached Algae	Algae										
Sessile filter feeder (TL-II)	bivalves (w/o shell)	0.012	0	0.036	0.024213411	581.8482643	6877.300342	0.020930914	0.24377539	0.0618957	24.4%
Invertibrate Omnivore (TL-II)	urchin	0.000675466	0	0.079181846	0.003163548	13.1069075	192.1012396	0.000847751	0.03471132	0.01002768	3.5%
Invertibrate Forager (TL-III)	crab	0.001158234	0	0.071193202	0.004642088	60.75673491	377.3221989	0.003592107	0.01678102	0.00900593	1.7%
Vertibrate Forager (TL-III)	triggerfish	0.015181024	-0.415	0.061	0.002837229	12.13142452	74.08503521	0.00084971	0.00907693	0.00520447	0.9%
Predator (TL-IV)	grouper	0.00279	-0.355	0.0811	0.001011362	4.324384181	26.40845301	0.000302889	0.00264734	0.00185519	0.3%
Benthic Community											
Infaunal invert. (TL-II)	polychaete	0.001682129	0	0.071034762	0.006721006	135.0382801	1903.064429	0.017565285	0.09800757	0.01820852	9.8%
Epifaunal invert. (TL-II)	nematode	0.001682129	0	0.071034762	0.006721006	135.0382801	2604.19343	0.0104949	0.09262416	0.02803154	9.3%
Forager (TL-III)	lobster	0.0035	-0.13	0.066	0.00471923	61.76639253	383.5925529	0.003651801	0.01899736	0.00915559	1.9%
Predator (TL-IV)	flounder	0.0046	-0.24	0.067	0.002486878	13.58174479	82.94195291	0.000744785	0.00974341	0.00456181	1.0%

Dietary Preferences

	Suspended Solids (Epilimnion)	Suspended Solids (Hypolimnion)	Sediment	Phytoplankton	Zooplankton	Pelagic Plankitivore	Attached Algae	Reef Sessile Filter Feeder	Invertebrate Omnivore	Reef Invertebrate Forager	Reef Vertebrate Forager	Infaunal Benthos	Epifaunal Benthos	Benthic Forager
Pelagic Community														
Phytoplankton (TL1)														
Zooplankton (TL-II)	15%	15%		70%										
Planktivore (TL-III)					100%									
Piscivore (TL-IV)					10%	90%								
Reef / Vessel Community														
Attached Algae														
Sessile filter feeder (TL-II)		10%		80%	10%									
Invertebrate Omnivore (TL-II)							80%	20%						
Invertebrate Forager (TL-III)		5%			5%	5%		35%	50%					
Vertebrate Forager (TL-III)						19%		19%	15%	22%		12.5%	12.5%	
Predator (TL-IV)										15%	60%	8%	8%	8%
Benthic Community														
Infaunal invert. (TL-II)			50%	30%	20%									
Epifaunal invert. (TL-II)			25%	30%	20%							25%		
Forager (TL-III)			5%									50%	45%	
Predator (TL-IV)			2%									20%	20%	58%

Water Exposures

		Upper Water Column	Lower Water Column	Vessel Interior	Sediment Pore Water
Pelagic Community					
Phytoplankton (TL1)	Algae	100%			
Zooplankton (TL-II)	copepods	50%	50%		
Planktivore (TL-III)	herring	80%	20%		
Piscivore (TL-IV)	jack	80%	20%		
Reef / Vessel Community					
Attached Algae	Algae		100%		
Sessile filter feeder (TL-II)	bivalves (w/o shell)		100%		
Invertebrate Omnivore (TL-II)	urchin		80%	20%	
Invertebrate Forager (TL-III)	crab		70%	30%	
Vertebrate Forager (TL-III)	triggerfish		70%	30%	
Predator (TL-IV)	grouper		80%	20%	
Benthic Community					
Infaunal invert. (TL-II)	polychaete		20%		80%
Epifaunal invert. (TL-II)	nematode		50%		50%
Forager (TL-III)	lobster		75%		25%
Predator (TL-IV)	flounder		90%		10%

Energy Estimates for Suspended Sediment and Bedded Sediment

	GE	ME	ME	as kcal/g-ww
Sediment (kcal/kg-oc)	11456	6873.6	0.6	0.01099776
Suspended Sediment (kcal/kg-oc)	11456	6873.6	0.6	0.1649664

Respiratory Efficiencies	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Low body weight (<100g)	4.335E-01	8.000E-01	8.000E-01	8.000E-01	4.492E-01	2.582E-01	2.018E-01	1.127E-01	5.303E-02	1.255E-02
High body weight (>100g)	5.000E-01	5.000E-01	5.000E-01	5.000E-01	3.769E-01	2.857E-01	2.526E-01	1.888E-01	1.295E-01	6.299E-02
Dietary Assimilation Efficiencies	27%	46%	53%	62%	69%	69%	68%	59%	44%	16%

Tissue Conc. (mg/kg-lipid)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Pelagic Community										
Phytoplankton (TL1)	8.750E-13	2.318E-08	1.865E-09	3.024E-08	3.972E-08	1.588E-09	6.506E-10	0.000E+00	2.932E-13	1.050E-15
Zooplankton (TL-II)	5.696E-09	2.115E-04	2.134E-05	4.027E-04	3.994E-04	5.714E-05	5.083E-05	0.000E+00	2.549E-07	3.768E-08
Planktivore (TL-III)	1.287E-09	1.791E-04	3.266E-05	1.194E-03	2.129E-03	3.349E-04	2.905E-04	0.000E+00	9.612E-07	5.060E-08
Piscivore (TL-IV)	3.366E-10	3.157E-05	8.670E-06	6.977E-04	3.731E-03	1.005E-03	9.822E-04	0.000E+00	2.869E-06	6.258E-08
Reef / Vessel Community										
Attached Algae	2.518E-09	6.778E-05	5.736E-06	9.533E-05	1.501E-04	1.460E-05	9.218E-06	0.000E+00	2.074E-08	9.272E-10
Sessile filter feeder (TL-II)	8.107E-08	2.734E-03	2.701E-04	5.079E-03	4.917E-03	4.355E-04	3.153E-04	0.000E+00	1.009E-06	1.095E-07
Invertebrate Omnivore (TL-II)	2.890E-07	2.243E-02	3.312E-03	1.065E-01	1.719E-01	1.213E-02	6.345E-03	0.000E+00	4.354E-06	5.640E-08
Invertebrate Forager (TL-III)	2.189E-06	8.926E-02	1.329E-02	4.483E-01	8.549E-01	6.748E-02	3.738E-02	0.000E+00	4.100E-05	2.699E-06
Vertebrate Forager (TL-III)	2.011E-07	1.411E-02	3.032E-03	1.776E-01	6.308E-01	6.375E-02	3.718E-02	0.000E+00	4.161E-05	1.377E-06
Predator (TL-IV)	1.114E-07	7.236E-03	1.709E-03	1.490E-01	1.149E+00	1.758E-01	1.126E-01	0.000E+00	1.210E-04	2.674E-06
Benthic Community										
Infaunal invert. (TL-II)	2.054E-08	8.067E-04	8.384E-05	1.658E-03	1.665E-03	1.524E-04	1.114E-04	0.000E+00	3.108E-07	2.215E-08
Epifaunal invert. (TL-II)	2.547E-08	1.500E-03	1.789E-04	4.050E-03	4.463E-03	4.277E-04	3.158E-04	0.000E+00	7.933E-07	4.350E-08
Forager (TL-III)	1.487E-08	8.214E-04	1.256E-04	3.795E-03	5.656E-03	5.288E-04	3.603E-04	0.000E+00	5.744E-07	1.318E-08
Predator (TL-IV)	1.317E-09	2.190E-04	5.772E-05	3.575E-03	1.077E-02	1.296E-03	9.152E-04	0.000E+00	1.176E-06	1.729E-08

Tissue Conc. (mg/kg-WW)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca	Total PCB
Pelagic Community											
Phytoplankton (TL1)	1.442E-14	3.819E-10	3.073E-11	4.983E-10	6.545E-10	2.618E-11	1.072E-11	0.000E+00	4.831E-15	1.730E-17	1.602E-09
Zooplankton (TL-II)	3.007E-10	1.117E-05	1.127E-06	2.126E-05	2.109E-05	3.017E-06	2.684E-06	0.000E+00	1.346E-08	1.989E-09	6.036E-05
Planktivore (TL-III)	9.043E-11	1.258E-05	2.294E-06	8.391E-05	1.495E-04	2.353E-05	2.041E-05	0.000E+00	6.753E-08	3.555E-09	2.923E-04
Piscivore (TL-IV)	2.364E-11	2.218E-06	6.091E-07	4.901E-05	2.621E-04	7.057E-05	6.900E-05	0.000E+00	2.016E-07	4.396E-09	4.537E-04
Reef / Vessel Community											
Attached Algae	4.150E-11	1.117E-06	9.453E-08	1.571E-06	2.474E-06	2.406E-07	1.519E-07	0.000E+00	3.418E-10	1.528E-11	5.649E-06
Sessile filter feeder (TL-II)	7.297E-10	2.461E-05	2.431E-06	4.571E-05	4.425E-05	3.919E-06	2.838E-06	0.000E+00	9.084E-09	9.857E-10	1.238E-04
Invertebrate Omnivore (TL-II)	1.509E-08	1.171E-03	1.729E-04	5.561E-03	8.973E-03	6.330E-04	3.312E-04	0.000E+00	2.273E-07	2.944E-09	1.684E-02
Invertebrate Forager (TL-III)	5.224E-08	2.131E-03	3.173E-04	1.070E-02	2.041E-02	1.611E-03	8.923E-04	0.000E+00	9.787E-07	6.442E-08	3.606E-02
Vertebrate Forager (TL-III)	1.413E-08	9.913E-04	2.130E-04	1.247E-02	4.432E-02	4.478E-03	2.612E-03	0.000E+00	2.923E-06	9.671E-08	6.509E-02
Predator (TL-IV)	7.825E-09	5.083E-04	1.201E-04	1.047E-02	8.075E-02	1.235E-02	7.909E-03	0.000E+00	8.499E-06	1.879E-07	1.121E-01
Benthic Community											
Infaunal invert. (TL-II)	1.965E-10	7.718E-06	8.022E-07	1.587E-05	1.593E-05	1.458E-06	1.066E-06	0.000E+00	2.974E-09	2.119E-10	4.285E-05
Epifaunal invert. (TL-II)	2.742E-10	1.615E-05	1.926E-06	4.359E-05	4.804E-05	4.604E-06	3.399E-06	0.000E+00	8.539E-09	4.682E-10	1.177E-04
Forager (TL-III)	3.550E-10	1.960E-05	2.998E-06	9.058E-05	1.350E-04	1.262E-05	8.600E-06	0.000E+00	1.371E-08	3.145E-10	2.694E-04
Predator (TL-IV)	7.241E-11	1.204E-05	3.175E-06	1.966E-04	5.925E-04	7.128E-05	5.034E-05	0.000E+00	6.471E-08	9.512E-10	9.260E-04

BAFs (L/kg-lipid)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Pelagic Community										
Phytoplankton (TL1)	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Zooplankton (TL-II)	1.347E+05	6.238E+05	7.437E+05	8.446E+05	5.320E+05	7.827E+05	1.103E+06	0.000E+00	2.458E+06	8.127E+06
Planktivore (TL-III)	7.603E+04	1.319E+06	2.843E+06	6.257E+06	7.083E+06	1.146E+07	1.575E+07	0.000E+00	2.317E+07	2.729E+07
Piscivore (TL-IV)	1.988E+04	2.326E+05	7.548E+05	3.655E+06	1.242E+07	3.439E+07	5.326E+07	0.000E+00	6.917E+07	3.375E+07
Reef / Vessel Community										
Attached Algae	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Sessile filter feeder (TL-II)	9.590E+05	4.034E+06	4.709E+06	5.328E+06	3.276E+06	2.983E+06	3.420E+06	0.000E+00	4.867E+06	1.181E+07
Invertebrate Omnivore (TL-II)	3.225E+04	3.121E+05	5.447E+05	1.054E+06	1.080E+06	7.834E+05	6.492E+05	0.000E+00	1.981E+05	5.738E+04
Invertebrate Forager (TL-III)	1.633E+05	8.307E+05	1.462E+06	2.966E+06	3.593E+06	2.916E+06	2.558E+06	0.000E+00	1.247E+06	1.836E+06
Vertebrate Forager (TL-III)	1.501E+04	1.313E+05	3.334E+05	1.175E+06	2.651E+06	2.754E+06	2.544E+06	0.000E+00	1.266E+06	9.366E+05
Predator (TL-IV)	1.243E+04	1.007E+05	2.810E+05	1.474E+06	7.223E+06	1.136E+07	1.152E+07	0.000E+00	5.503E+06	2.721E+06
Benthic Community										
Infaunal invert. (TL-II)	2.429E+05	1.190E+06	1.462E+06	1.740E+06	1.109E+06	1.044E+06	1.208E+06	0.000E+00	1.499E+06	2.389E+06
Epifaunal invert. (TL-II)	3.013E+05	2.213E+06	3.119E+06	4.248E+06	2.973E+06	2.930E+06	3.425E+06	0.000E+00	3.825E+06	4.691E+06
Forager (TL-III)	1.759E+05	1.212E+06	2.189E+06	3.981E+06	3.768E+06	3.622E+06	3.909E+06	0.000E+00	2.770E+06	1.421E+06
Predator (TL-IV)	1.557E+04	3.231E+05	1.006E+06	3.750E+06	7.177E+06	8.877E+06	9.928E+06	0.000E+00	5.673E+06	1.865E+06

Notes:
Kow = octanol to water partitioning coefficient, Koc = organic carbon partitioning coefficient, Kdoc = dissolved organic carbon partitioning coefficient
TL = trophic level, ww = wet weight

PCB MODELING RESULTS - PROSPECTIVE RISK EVALUATION

RISK ESTIMATES FOR Ex-Oriskany CV34

ZOI = 3	Cancer Risk Adult & Child		Hazard Adult & Child		Cancer Risk Child		Hazard Child	
RISK ESTIMATES	RME	CTE	RME	CTE	RME	CTE	RME	CTE
Benthic fish (flounder)	5.70E-08	4.41E-09	3.32E-03	7.62E-04	1.67E-08	3.39E-09	4.88E-03	8.79E-04
Benthic shellfish (lobster)	1.66E-08	1.28E-09	9.67E-04	2.22E-04	4.86E-09	9.87E-10	1.42E-03	2.56E-04
Pelagic fish (jack)	2.79E-08	2.16E-09	1.63E-03	3.74E-04	8.19E-09	1.66E-09	2.39E-03	4.31E-04
Reef fish TL-IV (grouper)	6.90E-06	5.34E-07	4.02E-01	9.23E-02	2.02E-06	4.11E-07	5.90E-01	1.06E-01
Reef fish TL-III (triggerfish)	4.00E-06	3.10E-07	2.34E-01	5.36E-02	1.17E-06	2.38E-07	3.43E-01	6.18E-02
Reef shellfish (crab)	2.22E-06	1.72E-07	1.29E-01	2.97E-02	6.51E-07	1.32E-07	1.90E-01	3.42E-02

PREDICTED EXPOSURE CONCENTRATIONS (mg/kg in fresh weight)	
Benthic fish (flounder)	9.26E-04
Benthic shellfish (lobster)	2.69E-04
Pelagic fish (jack)	4.54E-04
Reef fish TL-IV (grouper)	1.12E-01
Reef fish TL-III (triggerfish)	6.51E-02
Reef shellfish (crab)	3.61E-02

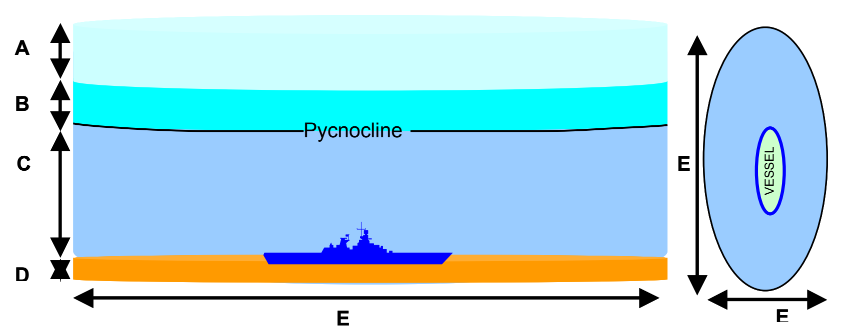
RISK INPUTS - Adult	RME	CTE
Body Weight (BWc) (kg)	70	70
Ingestion Rate (IRc) (kg/day)	0.0261	0.0072
Exposure Duration (EDc) (years)	24	3
Exposure Frequency (EFc) (days)	365	365
Averaging Time for cancer (ATc)	25550	25550
Slope Factor (mg/kg-day)	2	1
Reference dose for PCBs (RfD) (mg/kg-day)	0.00002	0.000045
Averaging Time for noncancer (ATnc-child)	8.76E+03	1.10E+03
Fractional Ingestion factor (FI)	0.17	0.25

RISK INPUTS - Child	RME	CTE
Body Weight (BWc) (kg)	15	15
Ingestion Rate (IRc) (kg/day)	0.0092916	0.0025632
Exposure Duration (EDc) (years)	6	6
Exposure Frequency (EFc) (days)	365	365
Averaging Time for cancer (ATc)	25550	25550
Slope Factor (mg/kg-day)	2	1
Reference dose for PCBs (RfD) (mg/kg-day)	0.00002	0.000045
Averaging Time for noncancer (ATnc-child)	2.19E+03	2.19E+03
Fractional Ingestion factor (FI)	0.17	0.25
Child - Adult IR scaling factor	0.356	

Zone of Influence Multiplier	3
Scenario run on	6/1/05 12:00

PCB-LADEN MATERIAL INPUTS	Fraction PCB	Release Rate (ng/g-d)	kg Material Onboard	PCB Release (ng/day)
Ventilation Gaskets	3.14E-05	1.58E+03	1.46E+03	7.23E+04
Lubricants	1.03E-04	2.20E+03	0.00E+00	0.00E+00
Foam Rubber Material	0.76%	2.62E+00	0.00E+00	0.00E+00
Black Rubber Material	5.29E-05	1.58E+03	5.40E+03	4.50E+05
Electrical Cable	1.85E-03	2.79E+02	2.96E+05	1.53E+08
Bulkhead Insulation Material	5.37E-04	6.76E+04	1.44E+04	5.22E+08
Aluminum Paint	2.00E-05	1.11E+04	3.87E+05	8.62E+07
Total				7.62E+08

Ex-Oriskany CV34	
Ex-Oriskany CV34	27100
Length (ft)	888
Beam (ft)	120



ZOI =	3	
Spatial Footprint on Ocean Floor		
	2.33E+04	m2
	9.01E-03	mile2
Modeled Dimensions Outside the Vessel		
A	1.00E+01	m
B	1.50E+01	m
C	5.00E+01	m
D	1.00E-01	m
E	3.25E+02	m
F	9.13E+01	m
Volumes		
Air Column		
Air	2.33E+05	m3
Upper Water Column		
Water	3.50E+05	m3
TSS	2.33E+00	m3
Lower Water Column		
Water	1.11E+06	m3
TSS	7.42E+00	m3
Inside Vessel		
Water	5.38E+04	m3
TSS	3.59E-01	m3
Sediment Bed		
Sediment	1.56E+03	m3

Abiotic Inputs	
Air Column	
Active air space height above water column (m)	10
Air current (m/h)	13677
Upper Water Column	
Temperature (oC)	24.5
Water depth (m)	15
Total suspended solids (mg/L)	10
Dissolved organic carbon (mg/L)	0.6
Dissolved oxygen (mg/L)	6.12
Lower Water Column	
Temperature (oC)	19.5
Water depth (m)	50
Total suspended solids (mg/L)	10
Dissolved organic carbon (mg/L)	0.6
Dissolved oxygen (mg/L)	4.59
Inside Vessel	
Temperature (oC)	19.5
Total suspended solids (mg/L)	10
Dissolved organic carbon (mg/L)	0.6
Dissolved oxygen (mg/L)	4.59
Sediment Bed	
Sediment density (g/cm3)	1.5
Active sediment depth (m)	0.1
Sediment fraction organic carbon	0.01
All Regions	
Suspended solids density (g/cm3)	1.5
Suspended solids fraction organic carbon	0.15
Dissolved organic carbon density (g/cm3)	1
Water current - to out of the ZOI (m/h)	926
Water current - inside to outside the vessel (m/h)	9.26

Total PCB concentrations		
Air Column		
Air	7.83E-17	g/m3
Upper Water Column		
Freely dissolved in water	9.72E-13	mg/L
Suspended solids	1.27E-08	mg/kg
Dissolved organic carbon	1.70E-07	mg/kg
Lower Water Column		
Freely dissolved in water	3.43E-09	mg/L
Suspended solids	8.43E-05	mg/kg
Dissolved organic carbon	7.72E-04	mg/kg
Inside Vessel		
Freely dissolved in water	1.80E-06	mg/L
Suspended solids	4.44E-02	mg/kg
Dissolved organic carbon	4.06E-01	mg/kg
Sediment Bed		
Freely dissolved in pore water	3.43E-09	mg/L
Bedded sediment	5.62E-06	mg/kg
Dissolved organic carbon in pore water	7.72E-04	mg/kg

Total PCB concentrations in biota			Percent Exposures	
Pelagic Community			Upper WC	Lower WC
Phytoplankton (TL-I)	1.60E-09	mg/kg	100%	0%
Zooplankton (TL-II)	6.04E-05	mg/kg	50%	50%
Planktivore (TL-III)	2.92E-04	mg/kg	80%	20%
Piscivore (TL-IV)	4.54E-04	mg/kg	80%	20%
Reef / Vessel Community			Lower WC	Vessel Int.
Attached Algae (TL-I)	5.65E-06	mg/kg	100%	0%
Sessile filter feeder (TL-II)	1.24E-04	mg/kg	100%	0%
Invertebrate Omnivore (TL-II)	1.68E-02	mg/kg	80%	20%
Invertebrate Forager (TL-III)	3.61E-02	mg/kg	70%	30%
Vertebrate Forager (TL-III)	6.51E-02	mg/kg	70%	30%
Predator (TL-IV)	1.12E-01	mg/kg	80%	20%
Benthic Community			Lower WC	Pore Water
Infaunal invert. (TL-II)	4.28E-05	mg/kg	20%	80%
Epifaunal invert. (TL-II)	1.18E-04	mg/kg	50%	50%
Forager (TL-III)	2.69E-04	mg/kg	75%	25%
Predator (TL-IV)	9.26E-04	mg/kg	90%	10%

PCB MODELING RESULTS - PROSPECTIVE RISK EVALUATION

RISK ESTIMATES FOR Ex-Oriskany CV34

Supplemental Information

Scenario Run on 6/1/05 12:02

ZOI+4

PCB Homolog	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Molecular Weight (g/mol)	1.89E+02	2.23E+02	2.58E+02	2.92E+02	3.26E+02	3.61E+02	3.95E+02	4.30E+02	4.64E+02	4.99E+02
Solubility (mg/L)	2.91E+00	6.78E-01	8.14E-02	6.67E-02	2.61E-02	9.50E-04	2.30E-04	2.11E-08	4.02E-09	1.69E-10
Solubility (mol/m^3)	1.54E-02	3.04E-03	3.16E-04	2.28E-04	8.00E-05	2.63E-06	5.82E-07	4.91E-11	8.65E-12	3.38E-13
Vapor Pressure (Pa)	6.32E-01	1.41E-01	5.11E-02	2.08E-02	2.96E-03	3.43E-03	2.56E-04	8.65E-05	2.77E-05	1.41E-05
Henry's (Pa-m^3/mol)	4.10E+01	4.65E+01	1.62E+02	9.10E+01	3.70E+01	1.30E+03	4.40E+02	1.76E+06	3.20E+06	4.18E+07
$\log_{10}K_{ow}$ =	4.47	5.24	5.52	5.92	6.50	6.98	7.19	7.70	8.35	9.60
$\log_{10}K_{oc}$ =	3.66	4.06	4.63	4.65	4.94	6.08	6.34	6.46	6.97	7.94
$\log_{10}K_{doc}$ =	3.34	4.11	4.39	4.79	5.51	5.85	6.06	6.57	7.22	8.47
Chemical emission rate (g/day)	1.37E-05	1.12E-01	9.95E-03	1.69E-01	3.20E-01	7.57E-02	7.37E-02	0.00E+00	8.28E-04	4.62E-04
Chemical emission rate (mol/hr)	3.03E-09	2.09E-05	1.61E-06	2.42E-05	4.08E-05	8.74E-06	7.77E-06	0.00E+00	7.43E-08	3.86E-08
Biodegradation in sediment (1/hr)	0	0	0	0	0	0	0	0	0	0
Biodegradation in water (1/hr)	0	0	0	0	0	0	0	0	0	0

	Ventilation Gaskets	Lubricants	Foam Rubber Material	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint
Fraction PCB in Material (wt/wt)	0.0000314	0.000103	0.76%	0.0000529	0.00185	0.000537	0.00002
Material Mass Onboard (kg)	1459	0	0	5397	296419	14379	386528
Total PCBs (kg)	0.0458126	0	0	0.2855013	548.37515	7.721523	7.73056
Total PCB Release rate (ng/g-PCB per day)	1.58E+03	2.20E+03	2.62E+00	1.58E+03	2.79E+02	6.76E+04	1.11E+04

Release Rates in nanograms PCB per gram of PCB within the Material	Ventilation Gaskets	Lubricants	Foam Rubber Material	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint
Monochlorobiphenyl	4.14E+01	3.47E+01	0.00E+00	4.14E+01	0.00E+00	0.00E+00	0.00E+00
Dichlorobiphenyl	1.27E+03	1.72E+02	3.08E-02	1.27E+03	2.03E+02	5.36E+00	0.00E+00
Trichlorobiphenyl	5.66E+01	8.97E+01	7.63E-02	5.66E+01	1.14E+00	9.44E+02	2.61E+02
Tetrachlorobiphenyl	1.44E+02	1.08E+03	1.29E+00	1.44E+02	1.57E+01	2.07E+04	1.23E+02
Pentachlorobiphenyl	6.31E+01	6.60E+02	3.90E-02	6.31E+01	1.80E+01	3.79E+04	2.24E+03
Hexachlorobiphenyl	0.00E+00	9.42E+01	5.34E-01	0.00E+00	2.41E+01	6.76E+03	1.33E+03
Heptachlorobiphenyl	5.04E+00	7.17E+01	6.46E-01	5.04E+00	1.47E+01	1.30E+03	7.19E+03
Octachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nonachlorobiphenyl	0.00E+00	0.00E+00	1.72E-03	0.00E+00	1.51E+00	0.00E+00	0.00E+00
Decachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.43E-01	0.00E+00	0.00E+00
Total	**1.58E+03**	**2.20E+03**	**2.62E+00**	**1.58E+03**	**2.79E+02**	**6.76E+04**	**1.11E+04**

Release Rates in nanograms PCB per Day	Ventilation Gaskets	Lubricants	Foam Rubber Material	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint	Total
Monochlorobiphenyl	1.90E+03	0.00E+00	0.00E+00	1.18E+04	0.00E+00	0.00E+00	0.00E+00	1.37E+04
Dichlorobiphenyl	5.80E+04	0.00E+00	0.00E+00	3.62E+05	1.11E+08	4.14E+04	0.00E+00	1.12E+08
Trichlorobiphenyl	2.59E+03	0.00E+00	0.00E+00	1.62E+04	6.25E+05	7.29E+06	2.02E+06	9.95E+06
Tetrachlorobiphenyl	6.60E+03	0.00E+00	0.00E+00	4.11E+04	8.61E+06	1.60E+08	9.51E+05	1.69E+08
Pentachlorobiphenyl	2.89E+03	0.00E+00	0.00E+00	1.80E+04	9.87E+06	2.93E+08	1.73E+07	3.20E+08
Hexachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E+07	5.22E+07	1.03E+07	7.57E+07
Heptachlorobiphenyl	2.31E+02	0.00E+00	0.00E+00	1.44E+03	8.06E+06	1.01E+07	5.56E+07	7.37E+07
Octachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nonachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.28E+05	0.00E+00	0.00E+00	8.28E+05
Decachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.62E+05	0.00E+00	0.00E+00	4.62E+05
Total	7.23E+04	0.00E+00	0.00E+00	4.50E+05	1.53E+08	5.22E+08	8.62E+07	7.62E+08

Air	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	4.24E-20	2.61E-16	1.72E-17	2.30E-16	2.51E-16	8.87E-18	3.16E-18	0.00E+00	1.12E-21	3.61E-24
Air concentration (g/m3)	3.26E-21	2.37E-17	1.80E-18	2.73E-17	3.34E-17	1.30E-18	5.09E-19	0.00E+00	2.12E-22	7.33E-25

Upper Water Column	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	6.23E-18	4.71E-14	1.14E-14	9.19E-14	4.40E-14	5.60E-14	7.07E-15	0.00E+00	1.97E-14	8.59E-16
Water concentration (mg/L)	2.86E-17	2.26E-13	1.82E-14	2.95E-13	3.87E-13	1.55E-14	6.34E-15	0.00E+00	2.86E-18	1.02E-20
Suspended solids concentration (mg/kg)	1.98E-14	3.87E-10	1.15E-10	2.00E-09	5.00E-09	2.79E-09	2.08E-09	0.00E+00	3.96E-12	1.34E-13
Dissolved organic carbon (mg/kg)	6.31E-14	2.88E-09	4.47E-10	1.82E-08	1.26E-07	1.08E-08	7.27E-09	0.00E+00	4.75E-11	3.04E-12

Lower Water Column	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	1.55E-14	1.19E-10	3.04E-11	2.51E-10	1.44E-10	4.45E-10	8.67E-11	0.00E+00	1.21E-09	6.57E-10
Water concentration (mg/L)	7.14E-14	5.72E-10	4.84E-11	8.05E-10	1.27E-09	1.23E-10	7.78E-11	0.00E+00	1.75E-13	7.83E-15
Suspended solids concentration (mg/kg)	4.93E-11	9.80E-07	3.06E-07	5.45E-06	1.64E-05	2.22E-05	2.55E-05	0.00E+00	2.43E-07	1.02E-07
Dissolved organic carbon (mg/kg)	1.57E-10	7.29E-06	1.19E-06	4.98E-05	4.13E-04	8.64E-05	8.92E-05	0.00E+00	2.91E-06	2.32E-06

Inside the Vessel	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	9.67E-12	7.43E-08	1.89E-08	1.56E-07	8.96E-08	2.77E-07	5.40E-08	0.00E+00	7.51E-07	4.09E-07
Water concentration (mg/L)	4.45E-11	3.57E-07	3.02E-08	5.02E-07	7.90E-07	7.68E-08	4.85E-08	0.00E+00	1.09E-10	4.88E-12
Suspended solids concentration (mg/kg)	3.07E-08	6.11E-04	1.91E-04	3.39E-03	1.02E-02	1.39E-02	1.59E-02	0.00E+00	1.51E-04	6.38E-05
Dissolved organic carbon (mg/kg)	9.80E-08	4.54E-03	7.41E-04	3.10E-02	2.57E-01	5.38E-02	5.56E-02	0.00E+00	1.81E-03	1.45E-03

Sediment Bed	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	1.55E-14	1.19E-10	3.04E-11	2.51E-10	1.44E-10	4.45E-10	8.67E-11	0.00E+00	1.21E-09	6.57E-10
Pore Water concentration (mg/L)	7.14E-14	5.72E-10	4.84E-11	8.05E-10	1.27E-09	1.23E-10	7.78E-11	0.00E+00	1.75E-13	7.83E-15
Sediment concentration (mg/kg)	3.29E-12	6.53E-08	2.04E-08	3.63E-07	1.09E-06	1.48E-06	1.70E-06	0.00E+00	1.62E-08	6.83E-09

Bioenergetic Inputs	Species	Body Weight	Lipid	Moisture	Caloric Density	GE to ME	Met Energy	Caloric Density	Production	Respiration	Excretion	Caloric Density	Met Energy
		(kg)	(%-dw)	(%)	(kcal/g-dry weight)	Fraction	(kcal/kg-lipid)	(kcal/kg-lipid)	(% of total)	(% of total)	(% of total)	(kcal/g-wt weight)	(kcal/g-wt weight)
Pelagic Community													
Phytoplankton (TL-I)	Algae		10%	84%	2.36	0.6	13748	22913				0.3776	0.22656
Zooplankton (TL-II)	copepods	0.000005	22%	76%	3.6	0.65	10636	16364	18%	24%	58%	0.864	0.5616
Planktivore (TL-III)	herring	0.05	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	1.225	0.8575
Piscivore (TL-IV)	jack	0.5	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	1.225	0.8575
Reef / Vessel Community													
Attached Algae (TL-I)	Algae		10%	84%	2.36	0.6	13748	22913				0.3776	0.22656
Sessile filter feeder (TL-II)	bivalves (w/o shell)	0.05	5%	82%	4.6	0.65	59800	92000	28%	31%	41%	0.828	0.5382
Invertebrate Omnivore (TL-II)	urchin	0.05	29%	82%	4.6	0.65	10310	15862	7%	25%	68%	0.828	0.5382
Invertebrate Forager (TL-III)	crab	1	9%	74%	2.7	0.65	19118	29412	28%	59%	13%	0.702	0.4563
Vertebrate Forager (TL-III)	triggerfish	1	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	1.225	0.8575
Predator (TL-IV)	grouper	1.5	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	0.2	0.14
Benthic Community													
Infaunal invert. (TL-II)	polychaete	0.01	6%	84%	4.6	0.65	50000	76923	71%	26%	3%	0.736	0.4784
Epifaunal invert. (TL-II)	nematode	0.01	6%	82%	4.6	0.65	50000	76923	31%	19%	50%	0.828	0.5382
Forager (TL-III)	lobster	2	9%	74%	2.7	0.65	19118	29412	28%	59%	13%	0.702	0.4563
Predator (TL-IV)	flounder	3	22%	75%	4.9	0.7	15591	22273	20%	60%	20%	1.225	0.8575

Bioenergetic Inputs		Respiration Rate Allometric Regression Parameters			Resp. Rate	Resp. Rate	Consumption	Growth Rate	Consumption	Consumption	
		a	b1	b2	1 / day	gO2 / kg-lipid-day	kcal / kg-lipid-day	1 / day	g-wt weight / g-wt weight-d	kcal / wet weight-da	As a % of body weight
Pelagic Community											
Phytoplankton (TL1)	Algae										
Zooplankton (TL-II)	copepods	0.006375522	0	0.039935335	0.015425453	84.24400867	1286.168071	0.014147849	0.32636028	0.06790967	32.6%
Planktivore (TL-III)	herring	0.0033	-0.227	0.0548	0.004949927	21.1649	129.2512977	0.001482433	0.01616792	0.0090799	1.6%
Piscivore (TL-IV)	jack	0.001118602	-0.55	0.12	0.000630951	2.697821256	16.47524431	0.000188961	0.00139796	0.00115739	0.1%
Reef / Vessel Community											
Attached Algae	Algae										
Sessile filter feeder (TL-II)	bivalves (w/o shell)	0.012	0	0.036	0.024213411	581.8482643	6877.300342	0.020930914	0.24377539	0.0618957	24.4%
Invertibrate Omnivore (TL-II)	urchin	0.000675466	0	0.079181846	0.003163548	13.1069075	192.1012396	0.000847751	0.03471132	0.01002768	3.5%
Invertibrate Forager (TL-III)	crab	0.001158234	0	0.071193202	0.004642088	60.75673491	377.3221989	0.003592107	0.01678102	0.00900593	1.7%
Vertibrate Forager (TL-III)	triggerfish	0.015181024	-0.415	0.061	0.002837229	12.13142452	74.08503521	0.00084971	0.00907693	0.00520447	0.9%
Predator (TL-IV)	grouper	0.00279	-0.355	0.0811	0.001011362	4.324384181	26.40845301	0.000302889	0.00264734	0.00185519	0.3%
Benthic Community											
Infaunal invert. (TL-II)	polychaete	0.001682129	0	0.071034762	0.006721006	135.0382801	1903.064429	0.017565285	0.09800757	0.01820852	9.8%
Epifaunal invert. (TL-II)	nematode	0.001682129	0	0.071034762	0.006721006	135.0382801	2604.19343	0.0104949	0.09262416	0.02803154	9.3%
Forager (TL-III)	lobster	0.0035	-0.13	0.066	0.00471923	61.76639253	383.5925529	0.003651801	0.01899736	0.00915559	1.9%
Predator (TL-IV)	flounder	0.0046	-0.24	0.067	0.002486878	13.58174479	82.94195291	0.000744785	0.00974341	0.00456181	1.0%

Dietary Preferences	Suspended Solids (Epilimnion)	Suspended Solids (Hypolimnion)	Sediment	Phytoplankton	Zooplankton	Pelagic Plankitivore	Attached Algae	Reef Sessile Filter Feeder	Invertebrate Omnivore	Reef Invertebrate Forager	Reef Vertebrate Forager	Infaunal Benthos	Epifaunal Benthos	Benthic Forager
Pelagic Community														
Phytoplankton (TL1)														
Zooplankton (TL-II)	15%	15%		70%										
Planktivore (TL-III)					100%									
Piscivore (TL-IV)					10%	90%								
Reef / Vessel Community														
Attached Algae														
Sessile filter feeder (TL-II)		10%		80%	10%									
Invertebrate Omnivore (TL-II)							80%	20%						
Invertebrate Forager (TL-III)		5%			5%	5%		35%	50%					
Vertebrate Forager (TL-III)						19%		19%	15%	22%		12.5%	12.5%	
Predator (TL-IV)										15%	60%	8%	8%	8%
Benthic Community														
Infaunal invert. (TL-II)			50%	30%	20%									
Epifaunal invert. (TL-II)			25%	30%	20%							25%		
Forager (TL-III)			5%									50%	45%	
Predator (TL-IV)			2%									20%	20%	58%

Water Exposures		Upper Water Column	Lower Water Column	Vessel Interior	Sediment Pore Water
Pelagic Community					
Phytoplankton (TL1)	Algae	100%			
Zooplankton (TL-II)	copepods	50%	50%		
Planktivore (TL-III)	herring	80%	20%		
Piscivore (TL-IV)	jack	80%	20%		
Reef / Vessel Community					
Attached Algae	Algae		100%		
Sessile filter feeder (TL-II)	bivalves (w/o shell)		100%		
Invertebrate Omnivore (TL-II)	urchin		80%	20%	
Invertebrate Forager (TL-III)	crab		70%	30%	
Vertebrate Forager (TL-III)	triggerfish		70%	30%	
Predator (TL-IV)	grouper		80%	20%	
Benthic Community					
Infaunal invert. (TL-II)	polychaete		20%		80%
Epifaunal invert. (TL-II)	nematode		50%		50%
Forager (TL-III)	lobster		75%		25%
Predator (TL-IV)	flounder		90%		10%

Energy Estimates for Suspended Sediment and Bedded Sediment	GE	ME	ME	as kcal/g-ww
Sediment (kcal/kg-oc)	11456	6873.6	0.6	0.01099776
Suspended Sediment (kcal/kg-oc)	11456	6873.6	0.6	0.1649664

Respiratory Efficiencies	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Low body weight (<100g)	4.335E-01	8.000E-01	8.000E-01	8.000E-01	4.492E-01	2.582E-01	2.018E-01	1.127E-01	5.303E-02	1.255E-02
High body weight (>100g)	5.000E-01	5.000E-01	5.000E-01	5.000E-01	3.769E-01	2.857E-01	2.526E-01	1.888E-01	1.295E-01	6.299E-02
Dietary Assimilation Efficiencies	27%	46%	53%	62%	69%	69%	68%	59%	44%	16%

Tissue Conc. (mg/kg-lipid)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Pelagic Community										
Phytoplankton (TL1)	8.531E-13	2.260E-08	1.818E-09	2.948E-08	3.872E-08	1.549E-09	6.345E-10	0.000E+00	2.859E-13	1.024E-15
Zooplankton (TL-II)	4.810E-09	1.786E-04	1.802E-05	3.401E-04	3.373E-04	4.826E-05	4.293E-05	0.000E+00	2.153E-07	3.182E-08
Planktivore (TL-III)	1.087E-09	1.513E-04	2.758E-05	1.009E-03	1.798E-03	2.828E-04	2.454E-04	0.000E+00	8.118E-07	4.273E-08
Piscivore (TL-IV)	2.843E-10	2.667E-05	7.323E-06	5.893E-04	3.151E-03	8.484E-04	8.295E-04	0.000E+00	2.423E-06	5.285E-08
Reef / Vessel Community										
Attached Algae	2.126E-09	5.724E-05	4.844E-06	8.050E-05	1.268E-04	1.233E-05	7.785E-06	0.000E+00	1.751E-08	7.830E-10
Sessile filter feeder (TL-II)	6.847E-08	2.309E-03	2.281E-04	4.289E-03	4.153E-03	3.678E-04	2.663E-04	0.000E+00	8.524E-07	9.249E-08
Invertebrate Omnivore (TL-II)	2.886E-07	2.238E-02	3.304E-03	1.062E-01	1.713E-01	1.206E-02	6.303E-03	0.000E+00	4.280E-06	5.404E-08
Invertebrate Forager (TL-III)	2.187E-06	8.913E-02	1.327E-02	4.471E-01	8.523E-01	6.720E-02	3.719E-02	0.000E+00	4.074E-05	2.693E-06
Vertebrate Forager (TL-III)	2.010E-07	1.408E-02	3.024E-03	1.770E-01	6.287E-01	6.345E-02	3.696E-02	0.000E+00	4.131E-05	1.372E-06
Predator (TL-IV)	1.113E-07	7.224E-03	1.705E-03	1.486E-01	1.146E+00	1.750E-01	1.120E-01	0.000E+00	1.203E-04	2.668E-06
Benthic Community										
Infaunal invert. (TL-II)	1.734E-08	6.813E-04	7.080E-05	1.401E-03	1.406E-03	1.287E-04	9.406E-05	0.000E+00	2.625E-07	1.871E-08
Epifaunal invert. (TL-II)	2.151E-08	1.267E-03	1.511E-04	3.420E-03	3.769E-03	3.612E-04	2.667E-04	0.000E+00	6.699E-07	3.673E-08
Forager (TL-III)	1.256E-08	6.936E-04	1.061E-04	3.205E-03	4.776E-03	4.466E-04	3.043E-04	0.000E+00	4.851E-07	1.113E-08
Predator (TL-IV)	1.112E-09	1.849E-04	4.875E-05	3.019E-03	9.098E-03	1.095E-03	7.729E-04	0.000E+00	9.936E-07	1.461E-08

Tissue Conc. (mg/kg-WW)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca	Total PCB
Pelagic Community											
Phytoplankton (TL1)	1.406E-14	3.724E-10	2.996E-11	4.859E-10	6.382E-10	2.552E-11	1.046E-11	0.000E+00	4.711E-15	1.687E-17	1.562E-09
Zooplankton (TL-II)	2.540E-10	9.431E-06	9.514E-07	1.796E-05	1.781E-05	2.548E-06	2.267E-06	0.000E+00	1.137E-08	1.680E-09	5.098E-05
Planktivore (TL-III)	7.638E-11	1.063E-05	1.938E-06	7.087E-05	1.263E-04	1.987E-05	1.724E-05	0.000E+00	5.703E-08	3.002E-09	2.469E-04
Piscivore (TL-IV)	1.997E-11	1.873E-06	5.144E-07	4.140E-05	2.214E-04	5.960E-05	5.827E-05	0.000E+00	1.702E-07	3.713E-09	3.832E-04
Reef / Vessel Community											
Attached Algae	3.504E-11	9.434E-07	7.983E-08	1.327E-06	2.089E-06	2.032E-07	1.283E-07	0.000E+00	2.886E-10	1.290E-11	4.771E-06
Sessile filter feeder (TL-II)	6.162E-10	2.078E-05	2.053E-06	3.860E-05	3.737E-05	3.310E-06	2.397E-06	0.000E+00	7.672E-09	8.324E-10	1.045E-04
Invertebrate Omnivore (TL-II)	1.507E-08	1.168E-03	1.725E-04	5.545E-03	8.940E-03	6.297E-04	3.290E-04	0.000E+00	2.234E-07	2.821E-09	1.678E-02
Invertebrate Forager (TL-III)	5.220E-08	2.127E-03	3.167E-04	1.067E-02	2.034E-02	1.604E-03	8.878E-04	0.000E+00	9.723E-07	6.427E-08	3.595E-02
Vertebrate Forager (TL-III)	1.412E-08	9.894E-04	2.125E-04	1.243E-02	4.416E-02	4.458E-03	2.597E-03	0.000E+00	2.902E-06	9.637E-08	6.486E-02
Predator (TL-IV)	7.815E-09	5.075E-04	1.198E-04	1.044E-02	8.048E-02	1.229E-02	7.868E-03	0.000E+00	8.451E-06	1.875E-07	1.117E-01
Benthic Community											
Infaunal invert. (TL-II)	1.659E-10	6.518E-06	6.774E-07	1.340E-05	1.345E-05	1.231E-06	8.999E-07	0.000E+00	2.512E-09	1.790E-10	3.619E-05
Epifaunal invert. (TL-II)	2.316E-10	1.364E-05	1.626E-06	3.681E-05	4.057E-05	3.888E-06	2.870E-06	0.000E+00	7.211E-09	3.954E-10	9.941E-05
Forager (TL-III)	2.998E-10	1.656E-05	2.531E-06	7.650E-05	1.140E-04	1.066E-05	7.263E-06	0.000E+00	1.158E-08	2.656E-10	2.275E-04
Predator (TL-IV)	6.115E-11	1.017E-05	2.681E-06	1.661E-04	5.004E-04	6.020E-05	4.251E-05	0.000E+00	5.465E-08	8.033E-10	7.821E-04

BAFs (L/kg-lipid)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Pelagic Community										
Phytoplankton (TL1)	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Zooplankton (TL-II)	1.347E+05	6.238E+05	7.437E+05	8.446E+05	5.320E+05	7.827E+05	1.103E+06	0.000E+00	2.458E+06	8.127E+06
Planktivore (TL-III)	7.602E+04	1.319E+06	2.843E+06	6.256E+06	7.082E+06	1.146E+07	1.575E+07	0.000E+00	2.317E+07	2.729E+07
Piscivore (TL-IV)	1.988E+04	2.325E+05	7.547E+05	3.655E+06	1.241E+07	3.439E+07	5.326E+07	0.000E+00	6.917E+07	3.375E+07
Reef / Vessel Community										
Attached Algae	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Sessile filter feeder (TL-II)	9.590E+05	4.034E+06	4.709E+06	5.328E+06	3.276E+06	2.983E+06	3.420E+06	0.000E+00	4.867E+06	1.181E+07
Invertebrate Omnivore (TL-II)	3.224E+04	3.118E+05	5.439E+05	1.052E+06	1.077E+06	7.802E+05	6.457E+05	0.000E+00	1.949E+05	5.504E+04
Invertebrate Forager (TL-III)	1.633E+05	8.300E+05	1.460E+06	2.961E+06	3.584E+06	2.905E+06	2.547E+06	0.000E+00	1.240E+06	1.833E+06
Vertebrate Forager (TL-III)	1.501E+04	1.311E+05	3.328E+05	1.172E+06	2.644E+06	2.744E+06	2.531E+06	0.000E+00	1.258E+06	9.340E+05
Predator (TL-IV)	1.243E+04	1.006E+05	2.807E+05	1.472E+06	7.207E+06	1.132E+07	1.147E+07	0.000E+00	5.478E+06	2.718E+06
Benthic Community										
Infaunal invert. (TL-II)	2.429E+05	1.190E+06	1.462E+06	1.740E+06	1.109E+06	1.044E+06	1.208E+06	0.000E+00	1.499E+06	2.389E+06
Epifaunal invert. (TL-II)	3.013E+05	2.213E+06	3.119E+06	4.248E+06	2.973E+06	2.930E+06	3.425E+06	0.000E+00	3.825E+06	4.691E+06
Forager (TL-III)	1.759E+05	1.212E+06	2.189E+06	3.981E+06	3.768E+06	3.622E+06	3.909E+06	0.000E+00	2.770E+06	1.421E+06
Predator (TL-IV)	1.557E+04	3.231E+05	1.006E+06	3.750E+06	7.177E+06	8.878E+06	9.928E+06	0.000E+00	5.673E+06	1.865E+06

Notes:
Kow = octanol to water partitioning coefficient, Koc = organic carbon partitioning coefficient, Kdoc = dissolved organic carbon partitioning coefficient
TL = trophic level, ww = wet weight

PCB MODELING RESULTS - PROSPECTIVE RISK EVALUATION

RISK ESTIMATES FOR Ex-Oriskany CV34

ZOI = 4	Cancer Risk Adult & Child		Hazard Adult & Child		Cancer Risk Child		Hazard Child	
RISK ESTIMATES	RME	CTE	RME	CTE	RME	CTE	RME	CTE
Benthic fish (flounder)	4.81E-08	3.73E-09	2.81E-03	6.44E-04	1.41E-08	2.86E-09	4.12E-03	7.42E-04
Benthic shellfish (lobster)	1.40E-08	1.08E-09	8.16E-04	1.87E-04	4.11E-09	8.33E-10	1.20E-03	2.16E-04
Pelagic fish (jack)	2.36E-08	1.83E-09	1.38E-03	3.16E-04	6.92E-09	1.40E-09	2.02E-03	3.64E-04
Reef fish TL-IV (grouper)	6.87E-06	5.32E-07	4.01E-01	9.20E-02	2.02E-06	4.09E-07	5.88E-01	1.06E-01
Reef fish TL-III (triggerfish)	3.99E-06	3.09E-07	2.33E-01	5.34E-02	1.17E-06	2.37E-07	3.41E-01	6.16E-02
Reef shellfish (crab)	2.21E-06	1.71E-07	1.29E-01	2.96E-02	6.49E-07	1.32E-07	1.89E-01	3.41E-02

PREDICTED EXPOSURE CONCENTRATIONS (mg/kg in fresh weight)	
Benthic fish (flounder)	7.82E-04
Benthic shellfish (lobster)	2.28E-04
Pelagic fish (jack)	3.83E-04
Reef fish TL-IV (grouper)	1.12E-01
Reef fish TL-III (triggerfish)	6.49E-02
Reef shellfish (crab)	3.60E-02

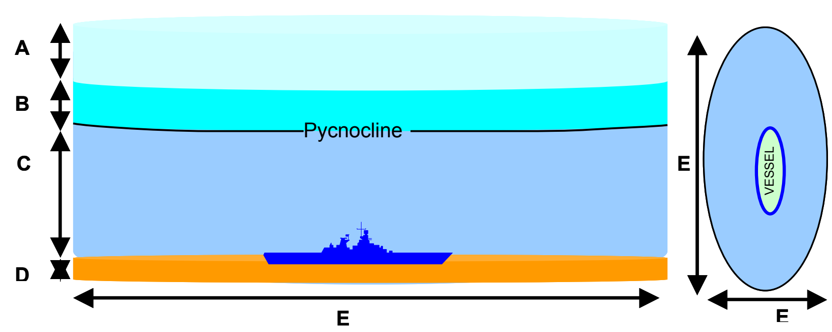
RISK INPUTS - Adult	RME	CTE
Body Weight (BWc) (kg)	70	70
Ingestion Rate (IRc) (kg/day)	0.0261	0.0072
Exposure Duration (EDc) (years)	24	3
Exposure Frequency (EFc) (days)	365	365
Averaging Time for cancer (ATc)	25550	25550
Slope Factor (mg/kg-day)	2	1
Reference dose for PCBs (RfD) (mg/kg-day)	0.00002	0.000045
Averaging Time for noncancer (ATnc-child)	8.76E+03	1.10E+03
Fractional Ingestion factor (FI)	0.17	0.25

RISK INPUTS - Child	RME	CTE
Body Weight (BWc) (kg)	15	15
Ingestion Rate (IRc) (kg/day)	0.0092916	0.0025632
Exposure Duration (EDc) (years)	6	6
Exposure Frequency (EFc) (days)	365	365
Averaging Time for cancer (ATc)	25550	25550
Slope Factor (mg/kg-day)	2	1
Reference dose for PCBs (RfD) (mg/kg-day)	0.00002	0.000045
Averaging Time for noncancer (ATnc-child)	2.19E+03	2.19E+03
Fractional Ingestion factor (FI)	0.17	0.25
Child - Adult IR scaling factor	0.356	

Zone of Influence Multiplier	4
Scenario run on	6/1/05 12:02

PCB-LADEN MATERIAL INPUTS	Fraction PCB	Release Rate (ng/g-d)	kg Material Onboard	PCB Release (ng/day)
Ventilation Gaskets	3.14E-05	1.58E+03	1.46E+03	7.23E+04
Lubricants	1.03E-04	2.20E+03	0.00E+00	0.00E+00
Foam Rubber Material	0.76%	2.62E+00	0.00E+00	0.00E+00
Black Rubber Material	5.29E-05	1.58E+03	5.40E+03	4.50E+05
Electrical Cable	1.85E-03	2.79E+02	2.96E+05	1.53E+08
Bulkhead Insulation Material	5.37E-04	6.76E+04	1.44E+04	5.22E+08
Aluminum Paint	2.00E-05	1.11E+04	3.87E+05	8.62E+07
Total				7.62E+08

Ex-Oriskany CV34	
Ex-Oriskany CV34	27100
Length (ft)	888
Beam (ft)	120



ZOI =	4	
Spatial Footprint on Ocean Floor		
	3.11E+04	m2
	1.20E-02	mile2
Modeled Dimensions Outside the Vessel		
A	1.00E+01	m
B	1.50E+01	m
C	5.00E+01	m
D	1.00E-01	m
E	3.48E+02	m
F	1.14E+02	m
Volumes		
Air Column		
Air	3.11E+05	m3
Upper Water Column		
Water	4.67E+05	m3
TSS	3.11E+00	m3
Lower Water Column		
Water	1.50E+06	m3
TSS	1.00E+01	m3
Inside Vessel		
Water	5.38E+04	m3
TSS	3.59E-01	m3
Sediment Bed		
Sediment	2.33E+03	m3

Abiotic Inputs	
Air Column	
Active air space height above water column (m)	10
Air current (m/h)	13677
Upper Water Column	
Temperature (oC)	24.5
Water depth (m)	15
Total suspended solids (mg/L)	10
Dissolved organic carbon (mg/L)	0.6
Dissolved oxygen (mg/L)	6.12
Lower Water Column	
Temperature (oC)	19.5
Water depth (m)	50
Total suspended solids (mg/L)	10
Dissolved organic carbon (mg/L)	0.6
Dissolved oxygen (mg/L)	4.59
Inside Vessel	
Temperature (oC)	19.5
Total suspended solids (mg/L)	10
Dissolved organic carbon (mg/L)	0.6
Dissolved oxygen (mg/L)	4.59
Sediment Bed	
Sediment density (g/cm3)	1.5
Active sediment depth (m)	0.1
Sediment fraction organic carbon	0.01
All Regions	
Suspended solids density (g/cm3)	1.5
Suspended solids fraction organic carbon	0.15
Dissolved organic carbon density (g/cm3)	1
Water current - to out of the ZOI (m/h)	926
Water current - inside to outside the vessel (m/h)	9.26

Total PCB concentrations		
Air Column		
Air	8.81E-17	g/m3
Upper Water Column		
Freely dissolved in water	9.48E-13	mg/L
Suspended solids	1.24E-08	mg/kg
Dissolved organic carbon	1.66E-07	mg/kg
Lower Water Column		
Freely dissolved in water	2.89E-09	mg/L
Suspended solids	7.12E-05	mg/kg
Dissolved organic carbon	6.52E-04	mg/kg
Inside Vessel		
Freely dissolved in water	1.80E-06	mg/L
Suspended solids	4.44E-02	mg/kg
Dissolved organic carbon	4.06E-01	mg/kg
Sediment Bed		
Freely dissolved in pore water	2.89E-09	mg/L
Bedded sediment	4.75E-06	mg/kg
Dissolved organic carbon in pore water	6.52E-04	mg/kg

Total PCB concentrations in biota			**Percent Exposures**	
Pelagic Community			**Upper WC**	**Lower WC**
Phytoplankton (TL-I)	1.56E-09	mg/kg	100%	0%
Zooplankton (TL-II)	5.10E-05	mg/kg	50%	50%
Planktivore (TL-III)	2.47E-04	mg/kg	80%	20%
Piscivore (TL-IV)	3.83E-04	mg/kg	80%	20%
Reef / Vessel Community			**Lower WC**	**Vessel Int.**
Attached Algae (TL-I)	4.77E-06	mg/kg	100%	0%
Sessile filter feeder (TL-II)	1.05E-04	mg/kg	100%	0%
Invertebrate Omnivore (TL-II)	1.68E-02	mg/kg	80%	20%
Invertebrate Forager (TL-III)	3.60E-02	mg/kg	70%	30%
Vertebrate Forager (TL-III)	6.49E-02	mg/kg	70%	30%
Predator (TL-IV)	1.12E-01	mg/kg	80%	20%
Benthic Community			**Lower WC**	**Pore Water**
Infaunal invert. (TL-II)	3.62E-05	mg/kg	20%	80%
Epifaunal invert. (TL-II)	9.94E-05	mg/kg	50%	50%
Forager (TL-III)	2.28E-04	mg/kg	75%	25%
Predator (TL-IV)	7.82E-04	mg/kg	90%	10%

PCB MODELING RESULTS - PROSPECTIVE RISK EVALUATION

RISK ESTIMATES FOR Ex-Oriskany CV34

Supplemental Information

Scenario Run on 5/26/05 8:48 **ZOI = 5**

PCB Homolog	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Molecular Weight (g/mol)	1.89E+02	2.23E+02	2.58E+02	2.92E+02	3.26E+02	3.61E+02	3.95E+02	4.30E+02	4.64E+02	4.99E+02
Solubility (mg/L)	2.91E+00	6.78E-01	8.14E-02	6.67E-02	2.61E-02	9.50E-04	2.30E-04	2.11E-08	4.02E-09	1.69E-10
Solubility (mol/m^3)	1.54E-02	3.04E-03	3.16E-04	2.28E-04	8.00E-05	2.63E-06	5.82E-07	4.91E-11	8.65E-12	3.38E-13
Vapor Pressure (Pa)	6.32E-01	1.41E-01	5.11E-02	2.08E-02	2.96E-03	3.43E-03	2.56E-04	8.65E-05	2.77E-05	1.41E-05
Henry's (Pa-m^3/mol)	4.10E+01	4.65E+01	1.62E+02	9.10E+01	3.70E+01	1.30E+03	4.40E+02	1.76E+06	3.20E+06	4.18E+07
$\log_{10}K_{ow}$ =	4.47	5.24	5.52	5.92	6.50	6.98	7.19	7.70	8.35	9.60
$\log_{10}K_{oc}$ =	3.66	4.06	4.63	4.65	4.94	6.08	6.34	6.46	6.97	7.94
$\log_{10}K_{doc}$ =	3.34	4.11	4.39	4.79	5.51	5.85	6.06	6.57	7.22	8.47
Chemical emission rate (g/day)	1.37E-05	1.12E-01	9.95E-03	1.69E-01	3.20E-01	7.57E-02	7.37E-02	0.00E+00	8.28E-04	4.62E-04
Chemical emission rate (mol/hr)	3.03E-09	2.09E-05	1.61E-06	2.42E-05	4.08E-05	8.74E-06	7.77E-06	0.00E+00	7.43E-08	3.86E-08
Biodegradation in sediment (1/hr)	0	0	0	0	0	0	0	0	0	0
Biodegradation in water (1/hr)	0	0	0	0	0	0	0	0	0	0

	Ventilation Gaskets	Lubricants	Foam Rubber Material	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint
Fraction PCB in Material (wt/wt)	0.0000314	0.000103	0.76%	0.0000529	0.00185	0.000537	0.00002
Material Mass Onboard (kg)	1459	0	0	5397	296419	14379	386528
Total PCBs (kg)	0.0458126	0	0	0.2855013	548.37515	7.721523	7.73056
Total PCB Release rate (ng/g-PCB per day)	1.58E+03	2.20E+03	2.62E+00	1.58E+03	2.79E+02	6.76E+04	1.11E+04

Release Rates in nanograms PCB per gram of PCB within the Material	Ventilation Gaskets	Lubricants	Foam Rubber Material	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint
Monochlorobiphenyl	4.14E+01	3.47E+01	0.00E+00	4.14E+01	0.00E+00	0.00E+00	0.00E+00
Dichlorobiphenyl	1.27E+03	1.72E+02	3.08E-02	1.27E+03	2.03E+02	5.36E+00	0.00E+00
Trichlorobiphenyl	5.66E+01	8.97E+01	7.63E-02	5.66E+01	1.14E+00	9.44E+02	2.61E+02
Tetrachlorobiphenyl	1.44E+02	1.08E+03	1.29E+00	1.44E+02	1.57E+01	2.07E+04	1.23E+02
Pentachlorobiphenyl	6.31E+01	6.60E+02	3.90E-02	6.31E+01	1.80E+01	3.79E+04	2.24E+03
Hexachlorobiphenyl	0.00E+00	9.42E+01	5.34E-01	0.00E+00	2.41E+01	6.76E+03	1.33E+03
Heptachlorobiphenyl	5.04E+00	7.17E+01	6.46E-01	5.04E+00	1.47E+01	1.30E+03	7.19E+03
Octachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nonachlorobiphenyl	0.00E+00	0.00E+00	1.72E-03	0.00E+00	1.51E+00	0.00E+00	0.00E+00
Decachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.43E-01	0.00E+00	0.00E+00
Total	**1.58E+03**	**2.20E+03**	**2.62E+00**	**1.58E+03**	**2.79E+02**	**6.76E+04**	**1.11E+04**

Release Rates in nanograms PCB per Day	Ventilation Gaskets	Lubricants	Foam Rubber Material	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint	Total
Monochlorobiphenyl	1.90E+03	0.00E+00	0.00E+00	1.18E+04	0.00E+00	0.00E+00	0.00E+00	1.37E+04
Dichlorobiphenyl	5.80E+04	0.00E+00	0.00E+00	3.62E+05	1.11E+08	4.14E+04	0.00E+00	1.12E+08
Trichlorobiphenyl	2.59E+03	0.00E+00	0.00E+00	1.62E+04	6.25E+05	7.29E+06	2.02E+06	9.95E+06
Tetrachlorobiphenyl	6.60E+03	0.00E+00	0.00E+00	4.11E+04	8.61E+06	1.60E+08	9.51E+05	1.69E+08
Pentachlorobiphenyl	2.89E+03	0.00E+00	0.00E+00	1.80E+04	9.87E+06	2.93E+08	1.73E+07	3.20E+08
Hexachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E+07	5.22E+07	1.03E+07	7.57E+07
Heptachlorobiphenyl	2.31E+02	0.00E+00	0.00E+00	1.44E+03	8.06E+06	1.01E+07	5.56E+07	7.37E+07
Octachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nonachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.28E+05	0.00E+00	0.00E+00	8.28E+05
Decachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.62E+05	0.00E+00	0.00E+00	4.62E+05
Total	7.23E+04	0.00E+00	0.00E+00	4.50E+05	1.53E+08	5.22E+08	8.62E+07	7.62E+08

Air	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	4.65E-20	2.86E-16	1.89E-17	2.52E-16	2.76E-16	9.75E-18	3.48E-18	0.00E+00	1.23E-21	3.97E-24
Air concentration (g/m3)	3.58E-21	2.60E-17	1.98E-18	3.00E-17	3.67E-17	1.43E-18	5.60E-19	0.00E+00	2.33E-22	8.06E-25

Upper Water Column	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	6.12E-18	4.63E-14	1.12E-14	9.04E-14	4.32E-14	5.50E-14	6.95E-15	0.00E+00	1.94E-14	8.44E-16
Water concentration (mg/L)	2.82E-17	2.22E-13	1.79E-14	2.90E-13	3.81E-13	1.52E-14	6.24E-15	0.00E+00	2.81E-18	1.01E-20
Suspended solids concentration (mg/kg)	1.95E-14	3.80E-10	1.13E-10	1.96E-09	4.92E-09	2.75E-09	2.05E-09	0.00E+00	3.89E-12	1.32E-13
Dissolved organic carbon (mg/kg)	6.21E-14	2.83E-09	4.39E-10	1.79E-08	1.24E-07	1.07E-08	7.15E-09	0.00E+00	4.67E-11	2.99E-12

Lower Water Column	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	1.37E-14	1.05E-10	2.67E-11	2.21E-10	1.27E-10	3.92E-10	7.63E-11	0.00E+00	1.06E-09	5.78E-10
Water concentration (mg/L)	6.28E-14	5.03E-10	4.26E-11	7.08E-10	1.11E-09	1.08E-10	6.85E-11	0.00E+00	1.54E-13	6.89E-15
Suspended solids concentration (mg/kg)	4.34E-11	8.62E-07	2.69E-07	4.79E-06	1.44E-05	1.96E-05	2.25E-05	0.00E+00	2.13E-07	9.01E-08
Dissolved organic carbon (mg/kg)	1.38E-10	6.41E-06	1.05E-06	4.38E-05	3.63E-04	7.60E-05	7.85E-05	0.00E+00	2.56E-06	2.04E-06

Inside the Vessel	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	9.67E-12	7.43E-08	1.89E-08	1.56E-07	8.96E-08	2.77E-07	5.40E-08	0.00E+00	7.51E-07	4.09E-07
Water concentration (mg/L)	4.45E-11	3.57E-07	3.02E-08	5.02E-07	7.90E-07	7.68E-08	4.85E-08	0.00E+00	1.09E-10	4.88E-12
Suspended solids concentration (mg/kg)	3.07E-08	6.11E-04	1.91E-04	3.39E-03	1.02E-02	1.39E-02	1.59E-02	0.00E+00	1.51E-04	6.38E-05
Dissolved organic carbon (mg/kg)	9.80E-08	4.54E-03	7.41E-04	3.10E-02	2.57E-01	5.38E-02	5.56E-02	0.00E+00	1.81E-03	1.45E-03

Sediment Bed	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	1.37E-14	1.05E-10	2.67E-11	2.21E-10	1.27E-10	3.92E-10	7.63E-11	0.00E+00	1.06E-09	5.78E-10
Pore Water concentration (mg/L)	6.28E-14	5.03E-10	4.26E-11	7.08E-10	1.11E-09	1.08E-10	6.85E-11	0.00E+00	1.54E-13	6.89E-15
Sediment concentration (mg/kg)	2.89E-12	5.75E-08	1.80E-08	3.19E-07	9.60E-07	1.30E-06	1.50E-06	0.00E+00	1.42E-08	6.01E-09

Bioenergetic Inputs	Species	Body Weight	Lipid	Moisture	Caloric Density	GE to ME	Met Energy	Caloric Density	Production	Respiration	Excretion	Caloric Density	Met Energy
		(kg)	(%-dw)	(%)	(kcal/g-dry weight)	Fraction	(kcal/kg-lipid)	(kcal/kg-lipid)	(% of total)	(% of total)	(% of total)	(kcal/g-wt weight)	(kcal/g-wt weight)
Pelagic Community													
Phytoplankton (TL-I)	Algae		10%	84%	2.36	0.6	13748	22913				0.3776	0.22656
Zooplankton (TL-II)	copepods	0.000005	22%	76%	3.6	0.65	10636	16364	18%	24%	58%	0.864	0.5616
Planktivore (TL-III)	herring	0.05	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	1.225	0.8575
Piscivore (TL-IV)	jack	0.5	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	1.225	0.8575
Reef / Vessel Community													
Attached Algae (TL-I)	Algae		10%	84%	2.36	0.6	13748	22913				0.3776	0.22656
Sessile filter feeder (TL-II)	bivalves (w/o shell)	0.05	5%	82%	4.6	0.65	59800	92000	28%	31%	41%	0.828	0.5382
Invertebrate Omnivore (TL-II)	urchin	0.05	29%	82%	4.6	0.65	10310	15862	7%	25%	68%	0.828	0.5382
Invertebrate Forager (TL-III)	crab	1	9%	74%	2.7	0.65	19118	29412	28%	59%	13%	0.702	0.4563
Vertebrate Forager (TL-III)	triggerfish	1	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	1.225	0.8575
Predator (TL-IV)	grouper	1.5	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	0.2	0.14
Benthic Community													
Infaunal invert. (TL-II)	polychaete	0.01	6%	84%	4.6	0.65	50000	76923	71%	26%	3%	0.736	0.4784
Epifaunal invert. (TL-II)	nematode	0.01	6%	82%	4.6	0.65	50000	76923	31%	19%	50%	0.828	0.5382
Forager (TL-III)	lobster	2	9%	74%	2.7	0.65	19118	29412	28%	59%	13%	0.702	0.4563
Predator (TL-IV)	flounder	3	22%	75%	4.9	0.7	15591	22273	20%	60%	20%	1.225	0.8575

Bioenergetic Inputs		Respiration Rate Allometric Regression Parameters			Resp. Rate	Resp. Rate	Consumption	Growth Rate	Consumption	Consumption	
		a	b1	b2	1 / day	gO2 / kg-lipid-day	kcal / kg-lipid-day	1 / day	g-wt weight / g-wt weight-d	kcal / -wet weight-da	As a % of body weight
Pelagic Community											
Phytoplankton (TL1)	Algae										
Zooplankton (TL-II)	copepods	0.006375522	0	0.039935335	0.015425453	84.24400867	1286.168071	0.014147849	0.32636028	0.06790967	32.6%
Planktivore (TL-III)	herring	0.0033	-0.227	0.0548	0.004949927	21.1649	129.2512977	0.001482433	0.01616792	0.0090799	1.6%
Piscivore (TL-IV)	jack	0.001118602	-0.55	0.12	0.000630951	2.697821256	16.47524431	0.000188961	0.00139796	0.00115739	0.1%
Reef / Vessel Community											
Attached Algae	Algae										
Sessile filter feeder (TL-II)	bivalves (w/o shell)	0.012	0	0.036	0.024213411	581.8482643	6877.300342	0.020930914	0.24377539	0.0618957	24.4%
Invertibrate Omnivore (TL-II)	urchin	0.000675466	0	0.079181846	0.003163548	13.1069075	192.1012396	0.000847751	0.03471132	0.01002768	3.5%
Invertibrate Forager (TL-III)	crab	0.001158234	0	0.071193202	0.004642088	60.75673491	377.3221989	0.003592107	0.01678102	0.00900593	1.7%
Vertibrate Forager (TL-III)	triggerfish	0.015181024	-0.415	0.061	0.002837229	12.13142452	74.08503521	0.00084971	0.00907693	0.00520447	0.9%
Predator (TL-IV)	grouper	0.00279	-0.355	0.0811	0.001011362	4.324384181	26.40845301	0.000302889	0.00264734	0.00185519	0.3%
Benthic Community											
Infaunal invert. (TL-II)	polychaete	0.001682129	0	0.071034762	0.006721006	135.0382801	1903.064429	0.017565285	0.09800757	0.01820852	9.8%
Epifaunal invert. (TL-II)	nematode	0.001682129	0	0.071034762	0.006721006	135.0382801	2604.19343	0.0104949	0.09262416	0.02803154	9.3%
Forager (TL-III)	lobster	0.0035	-0.13	0.066	0.00471923	61.76639253	383.5925529	0.003651801	0.01899736	0.00915559	1.9%
Predator (TL-IV)	flounder	0.0046	-0.24	0.067	0.002486878	13.58174479	82.94195291	0.000744785	0.00974341	0.00456181	1.0%

Dietary Preferences	Suspended Solids (Epilimnion)	Suspended Solids (Hypolimnion)	Sediment	Phytoplankton	Zooplankton	Pelagic Plankitivore	Attached Algae	Reef Sessile Filter Feeder	Invertebrate Omnivore	Reef Invertebrate Forager	Reef Vertebrate Forager	Infaunal Benthos	Epifaunal Benthos	Benthic Forager
Pelagic Community														
Phytoplankton (TL1)														
Zooplankton (TL-II)	15%	15%		70%										
Planktivore (TL-III)					100%									
Piscivore (TL-IV)					10%	90%								
Reef / Vessel Community														
Attached Algae														
Sessile filter feeder (TL-II)		10%		80%	10%									
Invertebrate Omnivore (TL-II)							80%	20%						
Invertebrate Forager (TL-III)		5%			5%	5%		35%	50%					
Vertebrate Forager (TL-III)						19%		19%	15%	22%		12.5%	12.5%	
Predator (TL-IV)										15%	60%	8%	8%	8%
Benthic Community														
Infaunal invert. (TL-II)			50%	30%	20%									
Epifaunal invert. (TL-II)			25%	30%	20%							25%		
Forager (TL-III)			5%									50%	45%	
Predator (TL-IV)			2%									20%	20%	58%

Water Exposures		Upper Water Column	Lower Water Column	Vessel Interior	Sediment Pore Water
Pelagic Community					
Phytoplankton (TL1)	Algae	100%			
Zooplankton (TL-II)	copepods	50%	50%		
Planktivore (TL-III)	herring	80%	20%		
Piscivore (TL-IV)	jack	80%	20%		
Reef / Vessel Community					
Attached Algae	Algae		100%		
Sessile filter feeder (TL-II)	bivalves (w/o shell)		100%		
Invertebrate Omnivore (TL-II)	urchin		80%	20%	
Invertebrate Forager (TL-III)	crab		70%	30%	
Vertebrate Forager (TL-III)	triggerfish		70%	30%	
Predator (TL-IV)	grouper		80%	20%	
Benthic Community					
Infaunal invert. (TL-II)	polychaete		20%		80%
Epifaunal invert. (TL-II)	nematode		50%		50%
Forager (TL-III)	lobster		75%		25%
Predator (TL-IV)	flounder		90%		10%

Energy Estimates for Suspended Sediment and Bedded Sediment	GE	ME	ME	as kcal/g-ww
Sediment (kcal/kg-oc)	11456	6873.6	0.6	0.01099776
Suspended Sediment (kcal/kg-oc)	11456	6873.6	0.6	0.1649664

Respiratory Efficiencies	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Low body weight (<100g)	4.335E-01	8.000E-01	8.000E-01	8.000E-01	4.492E-01	2.582E-01	2.018E-01	1.127E-01	5.303E-02	1.255E-02
High body weight (>100g)	5.000E-01	5.000E-01	5.000E-01	5.000E-01	3.769E-01	2.857E-01	2.526E-01	1.888E-01	1.295E-01	6.299E-02
Dietary Assimilation Efficiencies	27%	46%	53%	62%	69%	69%	68%	59%	44%	16%

Tissue Conc. (mg/kg-lipid)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Pelagic Community										
Phytoplankton (TL1)	8.387E-13	2.222E-08	1.787E-09	2.899E-08	3.807E-08	1.523E-09	6.239E-10	0.000E+00	2.811E-13	1.007E-15
Zooplankton (TL-II)	4.231E-09	1.571E-04	1.585E-05	2.991E-04	2.967E-04	4.244E-05	3.776E-05	0.000E+00	1.893E-07	2.799E-08
Planktivore (TL-III)	9.564E-10	1.331E-04	2.426E-05	8.873E-04	1.581E-03	2.488E-04	2.158E-04	0.000E+00	7.140E-07	3.758E-08
Piscivore (TL-IV)	2.501E-10	2.346E-05	6.441E-06	5.183E-04	2.772E-03	7.462E-04	7.296E-04	0.000E+00	2.131E-06	4.648E-08
Reef / Vessel Community										
Attached Algae	1.870E-09	5.035E-05	4.260E-06	7.080E-05	1.115E-04	1.084E-05	6.847E-06	0.000E+00	1.540E-08	6.887E-10
Sessile filter feeder (TL-II)	6.022E-08	2.031E-03	2.006E-04	3.773E-03	3.652E-03	3.235E-04	2.342E-04	0.000E+00	7.497E-07	8.135E-08
Invertebrate Omnivore (TL-II)	2.883E-07	2.235E-02	3.298E-03	1.060E-01	1.708E-01	1.202E-02	6.275E-03	0.000E+00	4.231E-06	5.249E-08
Invertebrate Forager (TL-III)	2.186E-06	8.904E-02	1.325E-02	4.464E-01	8.506E-01	6.702E-02	3.707E-02	0.000E+00	4.056E-05	2.689E-06
Vertebrate Forager (TL-III)	2.009E-07	1.406E-02	3.019E-03	1.767E-01	6.272E-01	6.326E-02	3.683E-02	0.000E+00	4.112E-05	1.369E-06
Predator (TL-IV)	1.112E-07	7.216E-03	1.703E-03	1.483E-01	1.143E+00	1.745E-01	1.116E-01	0.000E+00	1.199E-04	2.665E-06
Benthic Community										
Infaunal invert. (TL-II)	1.525E-08	5.992E-04	6.227E-05	1.232E-03	1.237E-03	1.132E-04	8.273E-05	0.000E+00	2.309E-07	1.645E-08
Epifaunal invert. (TL-II)	1.892E-08	1.114E-03	1.329E-04	3.008E-03	3.315E-03	3.177E-04	2.345E-04	0.000E+00	5.892E-07	3.231E-08
Forager (TL-III)	1.105E-08	6.101E-04	9.328E-05	2.819E-03	4.201E-03	3.928E-04	2.676E-04	0.000E+00	4.266E-07	9.788E-09
Predator (TL-IV)	9.779E-10	1.627E-04	4.287E-05	2.656E-03	8.002E-03	9.627E-04	6.798E-04	0.000E+00	8.739E-07	1.285E-08

Tissue Conc. (mg/kg-WW)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca	Total PCB
Pelagic Community											
Phytoplankton (TL1)	1.382E-14	3.661E-10	2.946E-11	4.777E-10	6.275E-10	2.510E-11	1.028E-11	0.000E+00	4.633E-15	1.659E-17	1.536E-09
Zooplankton (TL-II)	2.234E-10	8.295E-06	8.368E-07	1.579E-05	1.567E-05	2.241E-06	1.994E-06	0.000E+00	9.996E-09	1.478E-09	4.484E-05
Planktivore (TL-III)	6.719E-11	9.348E-06	1.704E-06	6.233E-05	1.111E-04	1.748E-05	1.516E-05	0.000E+00	5.016E-08	2.640E-09	2.172E-04
Piscivore (TL-IV)	1.757E-11	1.648E-06	4.525E-07	3.641E-05	1.947E-04	5.242E-05	5.125E-05	0.000E+00	1.497E-07	3.265E-09	3.371E-04
Reef / Vessel Community											
Attached Algae	3.082E-11	8.297E-07	7.021E-08	1.167E-06	1.837E-06	1.787E-07	1.128E-07	0.000E+00	2.538E-10	1.135E-11	4.196E-06
Sessile filter feeder (TL-II)	5.420E-10	1.828E-05	1.806E-06	3.395E-05	3.287E-05	2.911E-06	2.108E-06	0.000E+00	6.748E-09	7.322E-10	9.194E-05
Invertebrate Omnivore (TL-II)	1.505E-08	1.167E-03	1.722E-04	5.534E-03	8.918E-03	6.275E-04	3.276E-04	0.000E+00	2.209E-07	2.740E-09	1.675E-02
Invertebrate Forager (TL-III)	5.217E-08	2.125E-03	3.163E-04	1.065E-02	2.030E-02	1.600E-03	8.848E-04	0.000E+00	9.682E-07	6.418E-08	3.588E-02
Vertebrate Forager (TL-III)	1.411E-08	9.880E-04	2.121E-04	1.241E-02	4.406E-02	4.444E-03	2.587E-03	0.000E+00	2.889E-06	9.615E-08	6.471E-02
Predator (TL-IV)	7.809E-09	5.069E-04	1.196E-04	1.042E-02	8.031E-02	1.226E-02	7.840E-03	0.000E+00	8.420E-06	1.872E-07	1.115E-01
Benthic Community											
Infaunal invert. (TL-II)	1.460E-10	5.733E-06	5.958E-07	1.179E-05	1.183E-05	1.083E-06	7.915E-07	0.000E+00	2.209E-09	1.574E-10	3.183E-05
Epifaunal invert. (TL-II)	2.037E-10	1.199E-05	1.431E-06	3.238E-05	3.568E-05	3.420E-06	2.525E-06	0.000E+00	6.343E-09	3.478E-10	8.744E-05
Forager (TL-III)	2.636E-10	1.456E-05	2.226E-06	6.728E-05	1.003E-04	9.375E-06	6.388E-06	0.000E+00	1.018E-08	2.336E-10	2.001E-04
Predator (TL-IV)	5.379E-11	8.946E-06	2.358E-06	1.461E-04	4.401E-04	5.295E-05	3.739E-05	0.000E+00	4.806E-08	7.065E-10	6.879E-04

BAFs (L/kg-lipid)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Pelagic Community										
Phytoplankton (TL1)	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Zooplankton (TL-II)	1.347E+05	6.238E+05	7.437E+05	8.446E+05	5.321E+05	7.827E+05	1.103E+06	0.000E+00	2.458E+06	8.127E+06
Planktivore (TL-III)	7.602E+04	1.319E+06	2.842E+06	6.256E+06	7.082E+06	1.146E+07	1.575E+07	0.000E+00	2.317E+07	2.729E+07
Piscivore (TL-IV)	1.988E+04	2.325E+05	7.546E+05	3.654E+06	1.241E+07	3.439E+07	5.326E+07	0.000E+00	6.917E+07	3.375E+07
Reef / Vessel Community										
Attached Algae	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Sessile filter feeder (TL-II)	9.590E+05	4.034E+06	4.709E+06	5.328E+06	3.276E+06	2.983E+06	3.420E+06	0.000E+00	4.867E+06	1.181E+07
Invertebrate Omnivore (TL-II)	3.223E+04	3.116E+05	5.434E+05	1.051E+06	1.076E+06	7.781E+05	6.433E+05	0.000E+00	1.928E+05	5.351E+04
Invertebrate Forager (TL-III)	1.633E+05	8.295E+05	1.459E+06	2.957E+06	3.579E+06	2.899E+06	2.540E+06	0.000E+00	1.235E+06	1.831E+06
Vertebrate Forager (TL-III)	1.500E+04	1.310E+05	3.324E+05	1.170E+06	2.639E+06	2.736E+06	2.523E+06	0.000E+00	1.252E+06	9.322E+05
Predator (TL-IV)	1.243E+04	1.006E+05	2.806E+05	1.470E+06	7.197E+06	1.130E+07	1.144E+07	0.000E+00	5.462E+06	2.716E+06
Benthic Community										
Infaunal invert. (TL-II)	2.429E+05	1.190E+06	1.462E+06	1.740E+06	1.109E+06	1.044E+06	1.208E+06	0.000E+00	1.499E+06	2.389E+06
Epifaunal invert. (TL-II)	3.013E+05	2.213E+06	3.119E+06	4.248E+06	2.973E+06	2.930E+06	3.425E+06	0.000E+00	3.825E+06	4.691E+06
Forager (TL-III)	1.759E+05	1.212E+06	2.189E+06	3.981E+06	3.768E+06	3.622E+06	3.909E+06	0.000E+00	2.770E+06	1.421E+06
Predator (TL-IV)	1.557E+04	3.231E+05	1.006E+06	3.751E+06	7.177E+06	8.878E+06	9.928E+06	0.000E+00	5.673E+06	1.865E+06

Notes:
Kow = octanol to water partitioning coefficient, Koc = organic carbon partitioning coefficient, Kdoc = dissolved organic carbon partitioning coefficient
TL = trophic level, ww = wet weight

PCB MODELING RESULTS - PROSPECTIVE RISK EVALUATION

RISK ESTIMATES FOR Ex-Oriskany CV34

ZOI = 5	Cancer Risk Adult & Child		Hazard Adult & Child		Cancer Risk Child		Hazard Child	
RISK ESTIMATES	RME	CTE	RME	CTE	RME	CTE	RME	CTE
Benthic fish (flounder)	4.23E-08	3.28E-09	2.47E-03	5.66E-04	1.24E-08	2.52E-09	3.62E-03	6.53E-04
Benthic shellfish (lobster)	1.23E-08	9.53E-10	7.18E-04	1.65E-04	3.61E-09	7.33E-10	1.05E-03	1.90E-04
Pelagic fish (jack)	2.07E-08	1.61E-09	1.21E-03	2.78E-04	6.08E-09	1.23E-09	1.77E-03	3.20E-04
Reef fish TL-IV (grouper)	6.86E-06	5.31E-07	4.00E-01	9.18E-02	2.01E-06	4.08E-07	5.87E-01	1.06E-01
Reef fish TL-III (triggerfish)	3.98E-06	3.08E-07	2.32E-01	5.33E-02	1.17E-06	2.37E-07	3.41E-01	6.14E-02
Reef shellfish (crab)	2.21E-06	1.71E-07	1.29E-01	2.95E-02	6.48E-07	1.31E-07	1.89E-01	3.41E-02

PREDICTED EXPOSURE CONCENTRATIONS (mg/kg in fresh weight)	
Benthic fish (flounder)	6.88E-04
Benthic shellfish (lobster)	2.00E-04
Pelagic fish (jack)	3.37E-04
Reef fish TL-IV (grouper)	1.11E-01
Reef fish TL-III (triggerfish)	6.47E-02
Reef shellfish (crab)	3.59E-02

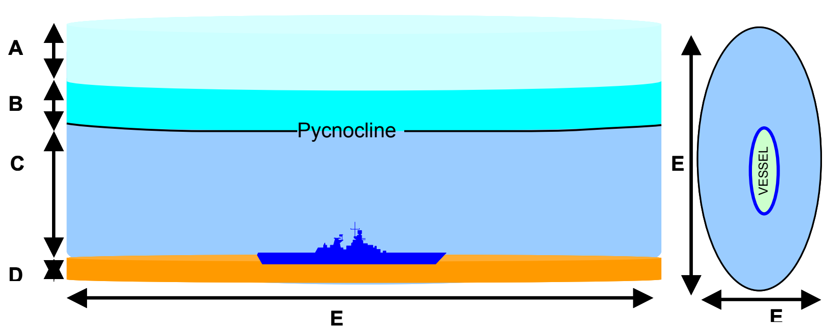
RISK INPUTS - Adult	RME	CTE
Body Weight (BWc) (kg)	70	70
Ingestion Rate (IRc) (kg/day)	0.0261	0.0072
Exposure Duration (EDc) (years)	24	3
Exposure Frequency (EFc) (days)	365	365
Averaging Time for cancer (ATc)	25550	25550
Slope Factor (mg/kg-day)	2	1
Reference dose for PCBs (RfD) (mg/kg-day)	0.00002	0.000045
Averaging Time for noncancer (ATnc-child)	8.76E+03	1.10E+03
Fractional Ingestion factor (FI)	0.17	0.25

RISK INPUTS - Child	RME	CTE
Body Weight (BWc) (kg)	15	15
Ingestion Rate (IRc) (kg/day)	0.0092916	0.0025632
Exposure Duration (EDc) (years)	6	6
Exposure Frequency (EFc) (days)	365	365
Averaging Time for cancer (ATc)	25550	25550
Slope Factor (mg/kg-day)	2	1
Reference dose for PCBs (RfD) (mg/kg-day)	0.00002	0.000045
Averaging Time for noncancer (ATnc-child)	2.19E+03	2.19E+03
Fractional Ingestion factor (FI)	0.17	0.25
Child - Adult IR scaling factor	0.356	

Zone of Influence Multiplier	5
Scenario run on	5/26/05 8:48

PCB-LADEN MATERIAL INPUTS	Fraction PCB	Release Rate (ng/g-d)	kg Material Onboard	PCB Release (ng/day)
Ventilation Gaskets	3.14E-05	1.58E+03	1.46E+03	7.23E+04
Lubricants	1.03E-04	2.20E+03	0.00E+00	0.00E+00
Foam Rubber Material	0.76%	2.62E+00	0.00E+00	0.00E+00
Black Rubber Material	5.29E-05	1.58E+03	5.40E+03	4.50E+05
Electrical Cable	1.85E-03	2.79E+02	2.96E+05	1.53E+08
Bulkhead Insulation Material	5.37E-04	6.76E+04	1.44E+04	5.22E+08
Aluminum Paint	2.00E-05	1.11E+04	3.87E+05	8.62E+07
Total				7.62E+08

Ex-Oriskany CV34	
Ex-Oriskany CV34	27100
Length (ft)	888
Beam (ft)	120



ZOI =	5
Spatial Footprint on Ocean Floor	
3.89E+04 m2	
1.50E-02 mile2	
Modeled Dimensions Outside the Vessel	
A	1.00E+01 m
B	1.50E+01 m
C	5.00E+01 m
D	1.00E-01 m
E	3.68E+02 m
F	1.34E+02 m
Volumes	
Air Column	
Air	3.89E+05 m3
Upper Water Column	
Water	5.83E+05 m3
TSS	3.89E+00 m3
Lower Water Column	
Water	1.89E+06 m3
TSS	1.26E+01 m3
Inside Vessel	
Water	5.38E+04 m3
TSS	3.59E-01 m3
Sediment Bed	
Sediment	3.11E+03 m3

Abiotic Inputs	
Air Column	
Active air space height above water column (m)	10
Air current (m/h)	13677
Upper Water Column	
Temperature (oC)	24.5
Water depth (m)	15
Total suspended solids (mg/L)	10
Dissolved organic carbon (mg/L)	0.6
Dissolved oxygen (mg/L)	6.12
Lower Water Column	
Temperature (oC)	19.5
Water depth (m)	50
Total suspended solids (mg/L)	10
Dissolved organic carbon (mg/L)	0.6
Dissolved oxygen (mg/L)	4.59
Inside Vessel	
Temperature (oC)	19.5
Total suspended solids (mg/L)	10
Dissolved organic carbon (mg/L)	0.6
Dissolved oxygen (mg/L)	4.59
Sediment Bed	
Sediment density (g/cm3)	1.5
Active sediment depth (m)	0.1
Sediment fraction organic carbon	0.01
All Regions	
Suspended solids density (g/cm3)	1.5
Suspended solids fraction organic carbon	0.15
Dissolved organic carbon density (g/cm3)	1
Water current - to out of the ZOI (m/h)	926
Water current - inside to outside the vessel (m/h)	9.26

Total PCB concentrations		
Air Column		
Air	9.68E-17	g/m3
Upper Water Column		
Freely dissolved in water	9.32E-13	mg/L
Suspended solids	1.22E-08	mg/kg
Dissolved organic carbon	1.63E-07	mg/kg
Lower Water Column		
Freely dissolved in water	2.55E-09	mg/L
Suspended solids	6.27E-05	mg/kg
Dissolved organic carbon	5.74E-04	mg/kg
Inside Vessel		
Freely dissolved in water	1.80E-06	mg/L
Suspended solids	4.44E-02	mg/kg
Dissolved organic carbon	4.06E-01	mg/kg
Sediment Bed		
Freely dissolved in pore water	2.55E-09	mg/L
Bedded sediment	4.18E-06	mg/kg
Dissolved organic carbon in pore water	5.74E-04	mg/kg

Total PCB concentrations in biota			**Percent Exposures**	
Pelagic Community			Upper WC	Lower WC
Phytoplankton (TL-I)	1.54E-09	mg/kg	100%	0%
Zooplankton (TL-II)	4.48E-05	mg/kg	50%	50%
Planktivore (TL-III)	2.17E-04	mg/kg	80%	20%
Piscivore (TL-IV)	3.37E-04	mg/kg	80%	20%
Reef / Vessel Community			Lower WC	Vessel Int.
Attached Algae (TL-I)	4.20E-06	mg/kg	100%	0%
Sessile filter feeder (TL-II)	9.19E-05	mg/kg	100%	0%
Invertebrate Omnivore (TL-II)	1.67E-02	mg/kg	80%	20%
Invertebrate Forager (TL-III)	3.59E-02	mg/kg	70%	30%
Vertebrate Forager (TL-III)	6.47E-02	mg/kg	70%	30%
Predator (TL-IV)	1.11E-01	mg/kg	80%	20%
Benthic Community			Lower WC	Pore Water
Infaunal invert. (TL-II)	3.18E-05	mg/kg	20%	80%
Epifaunal invert. (TL-II)	8.74E-05	mg/kg	50%	50%
Forager (TL-III)	2.00E-04	mg/kg	75%	25%
Predator (TL-IV)	6.88E-04	mg/kg	90%	10%

Scenario Run on 6/1/05 12:03 ZOI=10

PCB Homolog	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Molecular Weight (g/mol)	1.89E+02	2.23E+02	2.58E+02	2.92E+02	3.26E+02	3.61E+02	3.95E+02	4.30E+02	4.64E+02	4.99E+02
Solubility (mg/L)	2.91E+00	6.78E-01	8.14E-02	6.67E-02	2.61E-02	9.50E-04	2.30E-04	2.11E-08	4.02E-09	1.69E-10
Solubility (mol/m^3)	1.54E-02	3.04E-03	3.16E-04	2.28E-04	8.00E-05	2.63E-06	5.82E-07	4.91E-11	8.65E-12	3.38E-13
Vapor Pressure (Pa)	6.32E-01	1.41E-01	5.11E-02	2.08E-02	2.96E-03	3.43E-03	2.56E-04	8.65E-05	2.77E-05	1.41E-05
Henry's (Pa-m^3/mol)	4.10E+01	4.65E+01	1.62E+02	9.10E+01	3.70E+01	1.30E+03	4.40E+02	1.76E+06	3.20E+06	4.18E+07
$\log_{10}K_{ow}$ =	4.47	5.24	5.52	5.92	6.50	6.98	7.19	7.70	8.35	9.60
$\log_{10}K_{oc}$ =	3.66	4.06	4.63	4.65	4.94	6.08	6.34	6.46	6.97	7.94
$\log_{10}K_{doc}$ =	3.34	4.11	4.39	4.79	5.51	5.85	6.06	6.57	7.22	8.47
Chemical emission rate (g/day)	1.37E-05	1.12E-01	9.95E-03	1.69E-01	3.20E-01	7.57E-02	7.37E-02	0.00E+00	8.28E-04	4.62E-04
Chemical emission rate (mol/hr)	3.03E-09	2.09E-05	1.61E-06	2.42E-05	4.08E-05	8.74E-06	7.77E-06	0.00E+00	7.43E-08	3.86E-08
Biodegradation in sediment (1/hr)	0	0	0	0	0	0	0	0	0	0
Biodegradation in water (1/hr)	0	0	0	0	0	0	0	0	0	0

	Ventilation Gaskets	Lubricants	Foam Rubber Material	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint
Fraction PCB in Material (wt/wt)	0.0000314	0.000103	0.76%	0.0000529	0.00185	0.000537	0.00002
Material Mass Onboard (kg)	1459	0	0	5397	296419	14379	386528
Total PCBs (kg)	0.0458126	0	0	0.2855013	548.37515	7.721523	7.73056
Total PCB Release rate (ng/g-PCB per day)	1.58E+03	2.20E+03	2.62E+00	1.58E+03	2.79E+02	6.76E+04	1.11E+04

Release Rates in nanograms PCB per gram of PCB within the Material	Ventilation Gaskets	Lubricants	Foam Rubber Material	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint
Monochlorobiphenyl	4.14E+01	3.47E+01	0.00E+00	4.14E+01	0.00E+00	0.00E+00	0.00E+00
Dichlorobiphenyl	1.27E+03	1.72E+02	3.08E-02	1.27E+03	2.03E+02	5.36E+00	0.00E+00
Trichlorobiphenyl	5.66E+01	8.97E+01	7.63E-02	5.66E+01	1.14E+00	9.44E+02	2.61E+02
Tetrachlorobiphenyl	1.44E+02	1.08E+03	1.29E+00	1.44E+02	1.57E+01	2.07E+04	1.23E+02
Pentachlorobiphenyl	6.31E+01	6.60E+02	3.90E-02	6.31E+01	1.80E+01	3.79E+04	2.24E+03
Hexachlorobiphenyl	0.00E+00	9.42E+01	5.34E-01	0.00E+00	2.41E+01	6.76E+03	1.33E+03
Heptachlorobiphenyl	5.04E+00	7.17E+01	6.46E-01	5.04E+00	1.47E+01	1.30E+03	7.19E+03
Octachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nonachlorobiphenyl	0.00E+00	0.00E+00	1.72E-03	0.00E+00	1.51E+00	0.00E+00	0.00E+00
Decachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.43E-01	0.00E+00	0.00E+00
Total	**1.58E+03**	**2.20E+03**	**2.62E+00**	**1.58E+03**	**2.79E+02**	**6.76E+04**	**1.11E+04**

Release Rates in nanograms PCB per Day	Ventilation Gaskets	Lubricants	Foam Rubber Material	Black Rubber Material	Electrical Cable	Bulkhead Insulation Material	Aluminized Paint	Total
Monochlorobiphenyl	1.90E+03	0.00E+00	0.00E+00	1.18E+04	0.00E+00	0.00E+00	0.00E+00	1.37E+04
Dichlorobiphenyl	5.80E+04	0.00E+00	0.00E+00	3.62E+05	1.11E+08	4.14E+04	0.00E+00	1.12E+08
Trichlorobiphenyl	2.59E+03	0.00E+00	0.00E+00	1.62E+04	6.25E+05	7.29E+06	2.02E+06	9.95E+06
Tetrachlorobiphenyl	6.60E+03	0.00E+00	0.00E+00	4.11E+04	8.61E+06	1.60E+08	9.51E+05	1.69E+08
Pentachlorobiphenyl	2.89E+03	0.00E+00	0.00E+00	1.80E+04	9.87E+06	2.93E+08	1.73E+07	3.20E+08
Hexachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E+07	5.22E+07	1.03E+07	7.57E+07
Heptachlorobiphenyl	2.31E+02	0.00E+00	0.00E+00	1.44E+03	8.06E+06	1.01E+07	5.56E+07	7.37E+07
Octachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nonachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.28E+05	0.00E+00	0.00E+00	8.28E+05
Decachlorobiphenyl	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.62E+05	0.00E+00	0.00E+00	4.62E+05
Total	7.23E+04	0.00E+00	0.00E+00	4.50E+05	1.53E+08	5.22E+08	8.62E+07	7.62E+08

Air	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	6.30E-20	3.88E-16	2.56E-17	3.42E-16	3.74E-16	1.32E-17	4.72E-18	0.00E+00	1.68E-21	5.39E-24
Air concentration (g/m3)	4.84E-21	3.52E-17	2.69E-18	4.07E-17	4.97E-17	1.95E-18	7.60E-19	0.00E+00	3.17E-22	1.10E-24

Upper Water Column	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	5.87E-18	4.44E-14	1.08E-14	8.67E-14	4.15E-14	5.28E-14	6.67E-15	0.00E+00	1.86E-14	8.11E-16
Water concentration (mg/L)	2.70E-17	2.13E-13	1.72E-14	2.78E-13	3.65E-13	1.46E-14	5.99E-15	0.00E+00	2.70E-18	9.67E-21
Suspended solids concentration (mg/kg)	1.87E-14	3.65E-10	1.09E-10	1.88E-09	4.72E-09	2.64E-09	1.97E-09	0.00E+00	3.74E-12	1.27E-13
Dissolved organic carbon (mg/kg)	5.96E-14	2.72E-09	4.21E-10	1.72E-08	1.19E-07	1.02E-08	6.87E-09	0.00E+00	4.48E-11	2.87E-12

Lower Water Column	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	9.27E-15	7.12E-11	1.82E-11	1.50E-10	8.59E-11	2.66E-10	5.18E-11	0.00E+00	7.20E-10	3.92E-10
Water concentration (mg/L)	4.26E-14	3.42E-10	2.89E-11	4.81E-10	7.57E-10	7.36E-11	4.65E-11	0.00E+00	1.05E-13	4.68E-15
Suspended solids concentration (mg/kg)	2.95E-11	5.85E-07	1.83E-07	3.25E-06	9.78E-06	1.33E-05	1.53E-05	0.00E+00	1.45E-07	6.12E-08
Dissolved organic carbon (mg/kg)	9.40E-11	4.36E-06	7.10E-07	2.97E-05	2.47E-04	5.16E-05	5.33E-05	0.00E+00	1.74E-06	1.39E-06

Inside the Vessel	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	9.67E-12	7.43E-08	1.89E-08	1.56E-07	8.96E-08	2.77E-07	5.40E-08	0.00E+00	7.51E-07	4.09E-07
Water concentration (mg/L)	4.45E-11	3.57E-07	3.02E-08	5.02E-07	7.90E-07	7.68E-08	4.85E-08	0.00E+00	1.09E-10	4.88E-12
Suspended solids concentration (mg/kg)	3.07E-08	6.11E-04	1.91E-04	3.39E-03	1.02E-02	1.39E-02	1.59E-02	0.00E+00	1.51E-04	6.38E-05
Dissolved organic carbon (mg/kg)	9.80E-08	4.54E-03	7.41E-04	3.10E-02	2.57E-01	5.38E-02	5.56E-02	0.00E+00	1.81E-03	1.45E-03

Sediment Bed	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Fugacity (Pa)	9.27E-15	7.12E-11	1.82E-11	1.50E-10	8.59E-11	2.66E-10	5.18E-11	0.00E+00	7.20E-10	3.92E-10
Pore Water concentration (mg/L)	4.26E-14	3.42E-10	2.89E-11	4.81E-10	7.57E-10	7.36E-11	4.65E-11	0.00E+00	1.05E-13	4.68E-15
Sediment concentration (mg/kg)	1.96E-12	3.90E-08	1.22E-08	2.17E-07	6.52E-07	8.85E-07	1.02E-06	0.00E+00	9.66E-09	4.08E-09

Bioenergetic Inputs	Species	Body Weight	Lipid	Moisture	Caloric Density	GE to ME	Met Energy	Caloric Density	Production	Respiration	Excretion	Caloric Density	Met Energy
		(kg)	(%-dw)	(%)	(kcal/g-dry weight)	Fraction	(kcal/kg-lipid)	(kcal/kg-lipid)	(% of total)	(% of total)	(% of total)	(kcal/g-wt weight)	(kcal/g-wt weight)
Pelagic Community													
Phytoplankton (TL-I)	Algae		10%	84%	2.36	0.6	13748	22913				0.3776	0.22656
Zooplankton (TL-II)	copepods	0.000005	22%	76%	3.6	0.65	10636	16364	18%	24%	58%	0.864	0.5616
Planktivore (TL-III)	herring	0.05	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	1.225	0.8575
Piscivore (TL-IV)	jack	0.5	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	1.225	0.8575
Reef / Vessel Community													
Attached Algae (TL-I)	Algae		10%	84%	2.36	0.6	13748	22913				0.3776	0.22656
Sessile filter feeder (TL-II)	bivalves (w/o shell)	0.05	5%	82%	4.6	0.65	59800	92000	28%	31%	41%	0.828	0.5382
Invertebrate Omnivore (TL-II)	urchin	0.05	29%	82%	4.6	0.65	10310	15862	7%	25%	68%	0.828	0.5382
Invertebrate Forager (TL-III)	crab	1	9%	74%	2.7	0.65	19118	29412	28%	59%	13%	0.702	0.4563
Vertebrate Forager (TL-III)	triggerfish	1	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	1.225	0.8575
Predator (TL-IV)	grouper	1.5	28%	75%	4.9	0.7	12206	17438	20%	60%	20%	0.2	0.14
Benthic Community													
Infaunal invert. (TL-II)	polychaete	0.01	6%	84%	4.6	0.65	50000	76923	71%	26%	3%	0.736	0.4784
Epifaunal invert. (TL-II)	nematode	0.01	6%	82%	4.6	0.65	50000	76923	31%	19%	50%	0.828	0.5382
Forager (TL-III)	lobster	2	9%	74%	2.7	0.65	19118	29412	28%	59%	13%	0.702	0.4563
Predator (TL-IV)	flounder	3	22%	75%	4.9	0.7	15591	22273	20%	60%	20%	1.225	0.8575

Bioenergetic Inputs		Respiration Rate Allometric Regression Parameters			Resp. Rate	Resp. Rate	Consumption	Growth Rate	Consumption	Consumption	
		a	b1	b2	1/day	gO2/kg-lipid-day	kcal/kg-lipid-day	1/day	g-wt weight/g-wt weight-d	kcal/-wet weight-da	As a % of body weight
Pelagic Community											
Phytoplankton (TL1)	Algae										
Zooplankton (TL-II)	copepods	0.006375522	0	0.039935335	0.015425453	84.24400867	1286.168071	0.014147849	0.32636028	0.06790967	32.6%
Planktivore (TL-III)	herring	0.0033	-0.227	0.0548	0.004949927	21.1649	129.2512977	0.001482433	0.01616792	0.0090799	1.6%
Piscivore (TL-IV)	jack	0.001118602	-0.55	0.12	0.000630951	2.697821256	16.47524431	0.000188961	0.00139796	0.00115739	0.1%
Reef / Vessel Community											
Attached Algae	Algae										
Sessile filter feeder (TL-II)	bivalves (w/o shell)	0.012	0	0.036	0.024213411	581.8482643	6877.300342	0.020930914	0.24377539	0.0618957	24.4%
Invertibrate Omnivore (TL-II)	urchin	0.000675466	0	0.079181846	0.003163548	13.1069075	192.1012396	0.00847751	0.03471132	0.01002768	3.5%
Invertibrate Forager (TL-III)	crab	0.001158234	0	0.071193202	0.004642088	60.75673491	377.3221989	0.003592107	0.01678102	0.00900593	1.7%
Vertibrate Forager (TL-III)	triggerfish	0.015181024	-0.415	0.061	0.002837229	12.13142452	74.08503521	0.00084971	0.00907693	0.00520447	0.9%
Predator (TL-IV)	grouper	0.00279	-0.355	0.0811	0.001011362	4.324384181	26.40845301	0.000302889	0.00264734	0.00185519	0.3%
Benthic Community											
Infaunal invert. (TL-II)	polychaete	0.001682129	0	0.071034762	0.006721006	135.0382801	1903.064429	0.017565285	0.09800757	0.01820852	9.8%
Epifaunal invert. (TL-II)	nematode	0.001682129	0	0.071034762	0.006721006	135.0382801	2604.19343	0.0104949	0.09262416	0.02803154	9.3%
Forager (TL-III)	lobster	0.0035	-0.13	0.066	0.00471923	61.76639253	383.5925529	0.003651801	0.01899736	0.00915559	1.9%
Predator (TL-IV)	flounder	0.0046	-0.24	0.067	0.002486878	13.58174479	82.94195291	0.000744785	0.00974341	0.00456181	1.0%

Dietary Preferences	Suspended Solids (Epilimnion)	Suspended Solids (Hypolimnion)	Sediment	Phytoplankton	Zooplankton	Pelagic Plankitivore	Attached Algae	Reef Sessile Filter Feeder	Invertebrate Omnivore	Reef Invertebrate Forager	Reef Vertebrate Forager	Infaunal Benthos	Epifaunal Benthos	Benthic Forager
Pelagic Community														
Phytoplankton (TL1)														
Zooplankton (TL-II)	15%	15%		70%										
Planktivore (TL-III)					100%									
Piscivore (TL-IV)					10%	90%								
Reef / Vessel Community														
Attached Algae														
Sessile filter feeder (TL-II)		10%		80%	10%									
Invertebrate Omnivore (TL-II)							80%	20%						
Invertebrate Forager (TL-III)		5%			5%	5%		35%	50%					
Vertebrate Forager (TL-III)						19%		19%	15%	22%		12.5%	12.5%	
Predator (TL-IV)										15%	60%	8%	8%	8%
Benthic Community														
Infaunal invert. (TL-II)			50%	30%	20%									
Epifaunal invert. (TL-II)			25%	30%	20%							25%		
Forager (TL-III)			5%									50%	45%	
Predator (TL-IV)			2%									20%	20%	58%

Water Exposures		Upper Water Column	Lower Water Column	Vessel Interior	Sediment Pore Water
Pelagic Community					
Phytoplankton (TL1)	Algae	100%			
Zooplankton (TL-II)	copepods	50%	50%		
Planktivore (TL-III)	herring	80%	20%		
Piscivore (TL-IV)	jack	80%	20%		
Reef / Vessel Community					
Attached Algae	Algae		100%		
Sessile filter feeder (TL-II)	bivalves (w/o shell)		100%		
Invertebrate Omnivore (TL-II)	urchin		80%	20%	
Invertebrate Forager (TL-III)	crab		70%	30%	
Vertebrate Forager (TL-III)	triggerfish		70%	30%	
Predator (TL-IV)	grouper		80%	20%	
Benthic Community					
Infaunal invert. (TL-II)	polychaete		20%		80%
Epifaunal invert. (TL-II)	nematode		50%		50%
Forager (TL-III)	lobster		75%		25%
Predator (TL-IV)	flounder		90%		10%

Energy Estimates for Suspended Sediment and Bedded Sediment	GE	ME	ME	as kcal/g-ww
Sediment (kcal/kg-oc)	11456	6873.6	0.6	0.01099776
Suspended Sediment (kcal/kg-oc)	11456	6873.6	0.6	0.1649664

Respiratory Efficiencies	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Low body weight (<100g)	4.335E-01	8.000E-01	8.000E-01	8.000E-01	4.492E-01	2.582E-01	2.018E-01	1.127E-01	5.303E-02	1.255E-02
High body weight (>100g)	5.000E-01	5.000E-01	5.000E-01	5.000E-01	3.769E-01	2.857E-01	2.526E-01	1.888E-01	1.295E-01	6.299E-02
Dietary Assimilation Efficiencies	27%	46%	53%	62%	69%	69%	68%	59%	44%	16%

Tissue Conc. (mg/kg-lipid)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Pelagic Community										
Phytoplankton (TL1)	8.048E-13	2.132E-08	1.715E-09	2.782E-08	3.655E-08	1.462E-09	5.990E-10	0.000E+00	2.699E-13	9.667E-16
Zooplankton (TL-II)	2.873E-09	1.067E-04	1.076E-05	2.032E-04	2.015E-04	2.882E-05	2.564E-05	0.000E+00	1.286E-07	1.900E-08
Planktivore (TL-III)	6.497E-10	9.038E-05	1.648E-05	6.027E-04	1.074E-03	1.689E-04	1.466E-04	0.000E+00	4.848E-07	2.552E-08
Piscivore (TL-IV)	1.699E-10	1.593E-05	4.375E-06	3.521E-04	1.883E-03	5.067E-04	4.954E-04	0.000E+00	1.447E-06	3.156E-08
Reef / Vessel Community										
Attached Algae	1.270E-09	3.418E-05	2.893E-06	4.807E-05	7.570E-05	7.363E-06	4.649E-06	0.000E+00	1.046E-08	4.676E-10
Sessile filter feeder (TL-II)	4.089E-08	1.379E-03	1.362E-04	2.562E-03	2.480E-03	2.197E-04	1.590E-04	0.000E+00	5.091E-07	5.524E-08
Invertebrate Omnivore (TL-II)	2.877E-07	2.227E-02	3.285E-03	1.055E-01	1.699E-01	1.192E-02	6.211E-03	0.000E+00	4.116E-06	4.887E-08
Invertebrate Forager (TL-III)	2.183E-06	8.883E-02	1.321E-02	4.447E-01	8.466E-01	6.659E-02	3.678E-02	0.000E+00	4.016E-05	2.679E-06
Vertebrate Forager (TL-III)	2.006E-07	1.402E-02	3.008E-03	1.758E-01	6.239E-01	6.281E-02	3.650E-02	0.000E+00	4.067E-05	1.361E-06
Predator (TL-IV)	1.110E-07	7.198E-03	1.697E-03	1.476E-01	1.137E+00	1.733E-01	1.107E-01	0.000E+00	1.188E-04	2.655E-06
Benthic Community										
Infaunal invert. (TL-II)	1.036E-08	4.069E-04	4.229E-05	8.365E-04	8.399E-04	7.687E-05	5.618E-05	0.000E+00	1.568E-07	1.117E-08
Epifaunal invert. (TL-II)	1.285E-08	7.566E-04	9.025E-05	2.043E-03	2.251E-03	2.158E-04	1.593E-04	0.000E+00	4.001E-07	2.194E-08
Forager (TL-III)	7.500E-09	4.142E-04	6.334E-05	1.914E-03	2.853E-03	2.667E-04	1.817E-04	0.000E+00	2.897E-07	6.646E-09
Predator (TL-IV)	6.640E-10	1.104E-04	2.911E-05	1.803E-03	5.434E-03	6.537E-04	4.616E-04	0.000E+00	5.934E-07	8.723E-09

Tissue Conc. (mg/kg-WW)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca	Total PCB
Pelagic Community											
Phytoplankton (TL1)	1.326E-14	3.513E-10	2.827E-11	4.585E-10	6.023E-10	2.410E-11	9.872E-12	0.000E+00	4.449E-15	1.593E-17	1.474E-09
Zooplankton (TL-II)	1.517E-10	5.634E-06	5.684E-07	1.073E-05	1.064E-05	1.522E-06	1.354E-06	0.000E+00	6.788E-09	1.003E-09	3.045E-05
Planktivore (TL-III)	4.564E-11	6.349E-06	1.158E-06	4.234E-05	7.545E-05	1.187E-05	1.030E-05	0.000E+00	3.406E-08	1.793E-09	1.475E-04
Piscivore (TL-IV)	1.194E-11	1.119E-06	3.074E-07	2.473E-05	1.323E-04	3.560E-05	3.480E-05	0.000E+00	1.017E-07	2.217E-09	2.289E-04
Reef / Vessel Community											
Attached Algae	2.093E-11	5.634E-07	4.767E-08	7.923E-07	1.248E-06	1.213E-07	7.662E-08	0.000E+00	1.724E-10	7.707E-12	2.849E-06
Sessile filter feeder (TL-II)	3.680E-10	1.241E-05	1.226E-06	2.306E-05	2.232E-05	1.977E-06	1.431E-06	0.000E+00	4.582E-09	4.971E-10	6.243E-05
Invertebrate Omnivore (TL-II)	1.502E-08	1.163E-03	1.715E-04	5.509E-03	8.868E-03	6.224E-04	3.242E-04	0.000E+00	2.149E-07	2.551E-09	1.666E-02
Invertebrate Forager (TL-III)	5.211E-08	2.120E-03	3.153E-04	1.061E-02	2.021E-02	1.589E-03	8.779E-04	0.000E+00	9.585E-07	6.394E-08	3.572E-02
Vertebrate Forager (TL-III)	1.409E-08	9.850E-04	2.113E-04	1.235E-02	4.383E-02	4.412E-03	2.564E-03	0.000E+00	2.857E-06	9.563E-08	6.436E-02
Predator (TL-IV)	7.795E-09	5.056E-04	1.192E-04	1.037E-02	7.990E-02	1.218E-02	7.776E-03	0.000E+00	8.347E-06	1.865E-07	1.109E-01
Benthic Community											
Infaunal invert. (TL-II)	9.910E-11	3.893E-06	4.046E-07	8.004E-06	8.036E-06	7.355E-07	5.375E-07	0.000E+00	1.500E-09	1.069E-10	2.161E-05
Epifaunal invert. (TL-II)	1.383E-10	8.144E-06	9.714E-07	2.199E-05	2.423E-05	2.322E-06	1.714E-06	0.000E+00	4.307E-09	2.361E-10	5.938E-05
Forager (TL-III)	1.790E-10	9.887E-06	1.512E-06	4.569E-05	6.809E-05	6.366E-06	4.337E-06	0.000E+00	6.915E-09	1.586E-10	1.359E-04
Predator (TL-IV)	3.652E-11	6.074E-06	1.601E-06	9.918E-05	2.989E-04	3.595E-05	2.539E-05	0.000E+00	3.264E-08	4.798E-10	4.671E-04

BAFs (L/kg-lipid)	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca
Pelagic Community										
Phytoplankton (TL1)	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Zooplankton (TL-II)	1.347E+05	6.239E+05	7.438E+05	8.447E+05	5.321E+05	7.827E+05	1.103E+06	0.000E+00	2.458E+06	8.127E+06
Planktivore (TL-III)	7.601E+04	1.319E+06	2.841E+06	6.254E+06	7.080E+06	1.146E+07	1.575E+07	0.000E+00	2.317E+07	2.729E+07
Piscivore (TL-IV)	1.988E+04	2.325E+05	7.544E+05	3.653E+06	1.241E+07	3.438E+07	5.325E+07	0.000E+00	6.917E+07	3.375E+07
Reef / Vessel Community										
Attached Algae	2.979E+04	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	0.000E+00	1.000E+05	1.000E+05
Sessile filter feeder (TL-II)	9.590E+05	4.035E+06	4.709E+06	5.329E+06	3.276E+06	2.983E+06	3.421E+06	0.000E+00	4.867E+06	1.181E+07
Invertebrate Omnivore (TL-II)	3.221E+04	3.111E+05	5.422E+05	1.048E+06	1.071E+06	7.733E+05	6.379E+05	0.000E+00	1.879E+05	4.991E+04
Invertebrate Forager (TL-III)	1.632E+05	8.284E+05	1.456E+06	2.949E+06	3.565E+06	2.883E+06	2.523E+06	0.000E+00	1.224E+06	1.827E+06
Vertebrate Forager (TL-III)	1.500E+04	1.308E+05	3.315E+05	1.166E+06	2.628E+06	2.720E+06	2.503E+06	0.000E+00	1.240E+06	9.282E+05
Predator (TL-IV)	1.243E+04	1.005E+05	2.801E+05	1.466E+06	7.174E+06	1.124E+07	1.137E+07	0.000E+00	5.425E+06	2.712E+06
Benthic Community										
Infaunal invert. (TL-II)	2.429E+05	1.190E+06	1.462E+06	1.740E+06	1.109E+06	1.044E+06	1.208E+06	0.000E+00	1.499E+06	2.389E+06
Epifaunal invert. (TL-II)	3.013E+05	2.213E+06	3.120E+06	4.249E+06	2.974E+06	2.930E+06	3.426E+06	0.000E+00	3.825E+06	4.691E+06
Forager (TL-III)	1.759E+05	1.212E+06	2.190E+06	3.982E+06	3.768E+06	3.622E+06	3.909E+06	0.000E+00	2.770E+06	1.421E+06
Predator (TL-IV)	1.557E+04	3.231E+05	1.006E+06	3.751E+06	7.178E+06	8.878E+06	9.929E+06	0.000E+00	5.673E+06	1.865E+06

Notes:
Kow = octanol to water partitioning coefficient, Koc = organic carbon partitioning coefficient, Kdoc = dissolved organic carbon partitioning coefficient
TL = trophic level, ww = wet weight

PCB MODELING RESULTS - PROSPECTIVE RISK EVALUATION

RISK ESTIMATES FOR Ex-Oriskany CV34

ZOI = 10	Cancer Risk Adult & Child		Hazard Adult & Child		Cancer Risk Child		Hazard Child	
RISK ESTIMATES	RME	CTE	RME	CTE	RME	CTE	RME	CTE
Benthic fish (flounder)	2.87E-08	2.23E-09	1.68E-03	3.85E-04	8.43E-09	1.71E-09	2.46E-03	4.43E-04
Benthic shellfish (lobster)	8.36E-09	6.47E-10	4.88E-04	1.12E-04	2.45E-09	4.98E-10	7.15E-04	1.29E-04
Pelagic fish (jack)	1.41E-08	1.09E-09	8.21E-04	1.88E-04	4.13E-09	8.38E-10	1.21E-03	2.17E-04
Reef fish TL-IV (grouper)	6.82E-06	5.28E-07	3.98E-01	9.13E-02	2.00E-06	4.06E-07	5.84E-01	1.05E-01
Reef fish TL-III (triggerfish)	3.96E-06	3.07E-07	2.31E-01	5.30E-02	1.16E-06	2.36E-07	3.39E-01	6.11E-02
Reef shellfish (crab)	2.20E-06	1.70E-07	1.28E-01	2.94E-02	6.45E-07	1.31E-07	1.88E-01	3.39E-02

PREDICTED EXPOSURE CONCENTRATIONS (mg/kg in fresh weight)	
Benthic fish (flounder)	4.67E-04
Benthic shellfish (lobster)	1.36E-04
Pelagic fish (jack)	2.29E-04
Reef fish TL-IV (grouper)	1.11E-01
Reef fish TL-III (triggerfish)	6.44E-02
Reef shellfish (crab)	3.57E-02

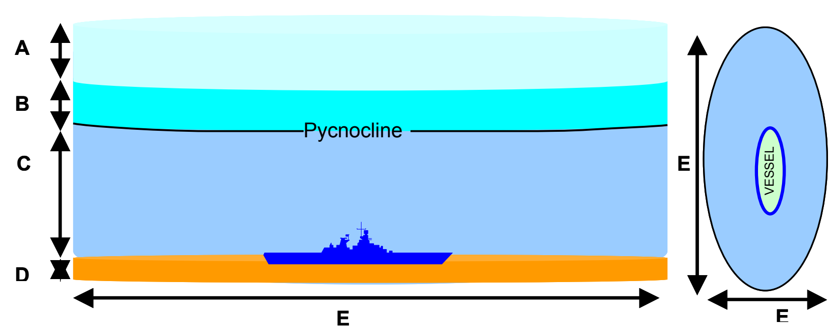
RISK INPUTS - Adult	RME	CTE
Body Weight (BWc) (kg)	70	70
Ingestion Rate (IRc) (kg/day)	0.0261	0.0072
Exposure Duration (EDc) (years)	24	3
Exposure Frequency (EFc) (days)	365	365
Averaging Time for cancer (ATc)	25550	25550
Slope Factor (mg/kg-day)	2	1
Reference dose for PCBs (RfD) (mg/kg-day)	0.00002	0.000045
Averaging Time for noncancer (ATnc-child)	8.76E+03	1.10E+03
Fractional Ingestion factor (FI)	0.17	0.25

RISK INPUTS - Child	RME	CTE
Body Weight (BWc) (kg)	15	15
Ingestion Rate (IRc) (kg/day)	0.0092916	0.0025632
Exposure Duration (EDc) (years)	6	6
Exposure Frequency (EFc) (days)	365	365
Averaging Time for cancer (ATc)	25550	25550
Slope Factor (mg/kg-day)	2	1
Reference dose for PCBs (RfD) (mg/kg-day)	0.00002	0.000045
Averaging Time for noncancer (ATnc-child)	2.19E+03	2.19E+03
Fractional Ingestion factor (FI)	0.17	0.25
Child - Adult IR scaling factor	0.356	

Zone of Influence Multiplier	10
Scenario run on	6/1/05 12:03

PCB-LADEN MATERIAL INPUTS	Fraction PCB	Release Rate (ng/g-d)	kg Material Onboard	PCB Release (ng/day)
Ventilation Gaskets	3.14E-05	1.58E+03	1.46E+03	7.23E+04
Lubricants	1.03E-04	2.20E+03	0.00E+00	0.00E+00
Foam Rubber Material	0.76%	2.62E+00	0.00E+00	0.00E+00
Black Rubber Material	5.29E-05	1.58E+03	5.40E+03	4.50E+05
Electrical Cable	1.85E-03	2.79E+02	2.96E+05	1.53E+08
Bulkhead Insulation Material	5.37E-04	6.76E+04	1.44E+04	5.22E+08
Aluminum Paint	2.00E-05	1.11E+04	3.87E+05	8.62E+07
Total				7.62E+08

Ex-Oriskany CV34	
Ex-Oriskany CV34	27100
Length (ft)	888
Beam (ft)	120



ZOI =	10	
Spatial Footprint on Ocean Floor		
	7.78E+04	m2
	3.00E-02	mile2
Modeled Dimensions Outside the Vessel		
A	1.00E+01	m
B	1.50E+01	m
C	5.00E+01	m
D	1.00E-01	m
E	4.53E+02	m
F	2.19E+02	m
Volumes		
Air Column		
Air	7.78E+05	m3
Upper Water Column		
Water	1.17E+06	m3
TSS	7.78E+00	m3
Lower Water Column		
Water	3.83E+06	m3
TSS	2.56E+01	m3
Inside Vessel		
Water	5.38E+04	m3
TSS	3.59E-01	m3
Sediment Bed		
Sediment	7.00E+03	m3

Abiotic Inputs	
Air Column	
Active air space height above water column (m)	10
Air current (m/h)	13677
Upper Water Column	
Temperature (oC)	24.5
Water depth (m)	15
Total suspended solids (mg/L)	10
Dissolved organic carbon (mg/L)	0.6
Dissolved oxygen (mg/L)	6.12
Lower Water Column	
Temperature (oC)	19.5
Water depth (m)	50
Total suspended solids (mg/L)	10
Dissolved organic carbon (mg/L)	0.6
Dissolved oxygen (mg/L)	4.59
Inside Vessel	
Temperature (oC)	19.5
Total suspended solids (mg/L)	10
Dissolved organic carbon (mg/L)	0.6
Dissolved oxygen (mg/L)	4.59
Sediment Bed	
Sediment density (g/cm3)	1.5
Active sediment depth (m)	0.1
Sediment fraction organic carbon	0.01
All Regions	
Suspended solids density (g/cm3)	1.5
Suspended solids fraction organic carbon	0.15
Dissolved organic carbon density (g/cm3)	1
Water current - to out of the ZOI (m/h)	926
Water current - inside to outside the vessel (m/h)	9.26

Total PCB concentrations		
Air Column		
Air	1.31E-16	g/m3
Upper Water Column		
Freely dissolved in water	8.95E-13	mg/L
Suspended solids	1.17E-08	mg/kg
Dissolved organic carbon	1.57E-07	mg/kg
Lower Water Column		
Freely dissolved in water	1.73E-09	mg/L
Suspended solids	4.25E-05	mg/kg
Dissolved organic carbon	3.90E-04	mg/kg
Inside Vessel		
Freely dissolved in water	1.80E-06	mg/L
Suspended solids	4.44E-02	mg/kg
Dissolved organic carbon	4.06E-01	mg/kg
Sediment Bed		
Freely dissolved in pore water	1.73E-09	mg/L
Bedded sediment	2.84E-06	mg/kg
Dissolved organic carbon in pore water	3.90E-04	mg/kg

Total PCB concentrations in biota			Percent Exposures	
Pelagic Community			Upper WC	Lower WC
Phytoplankton (TL-I)	1.47E-09	mg/kg	100%	0%
Zooplankton (TL-II)	3.05E-05	mg/kg	50%	50%
Planktivore (TL-III)	1.47E-04	mg/kg	80%	20%
Piscivore (TL-IV)	2.29E-04	mg/kg	80%	20%
Reef / Vessel Community			Lower WC	Vessel Int.
Attached Algae (TL-I)	2.85E-06	mg/kg	100%	0%
Sessile filter feeder (TL-II)	6.24E-05	mg/kg	100%	0%
Invertebrate Omnivore (TL-II)	1.67E-02	mg/kg	80%	20%
Invertebrate Forager (TL-III)	3.57E-02	mg/kg	70%	30%
Vertebrate Forager (TL-III)	6.44E-02	mg/kg	70%	30%
Predator (TL-IV)	1.11E-01	mg/kg	80%	20%
Benthic Community			Lower WC	Pore Water
Infaunal invert. (TL-II)	2.16E-05	mg/kg	20%	80%
Epifaunal invert. (TL-II)	5.94E-05	mg/kg	50%	50%
Forager (TL-III)	1.36E-04	mg/kg	75%	25%
Predator (TL-IV)	4.67E-04	mg/kg	90%	10%

B.3 Summary of Total PCBs concentrations modeled for biological and abiotic compartments as a function of ZOI.						
ZOI	1	2	3	4	5	10
Tissue Conc. (mg/kg-WW)	Total PCB	Total PCB	Total PCB	Total PCB	Total PCB	Total PCB
Pelagic Community						
Phytoplankton (TL1)	1.86E-09	1.67E-09	1.60E-09	1.56E-09	1.54E-09	1.47E-09
Zooplankton (TL-II)	1.21E-04	7.72E-05	6.04E-05	5.10E-05	4.48E-05	3.05E-05
Planktivore (TL-III)	5.88E-04	3.74E-04	2.92E-04	2.47E-04	2.17E-04	1.47E-04
Piscivore (TL-IV)	9.13E-04	5.80E-04	4.54E-04	3.83E-04	3.37E-04	2.29E-04
Reef / Vessel Community						
Attached Algae	1.14E-05	7.23E-06	5.65E-06	4.77E-06	4.20E-06	2.85E-06
Sessile filter feeder (TL-II)	2.49E-04	1.58E-04	1.24E-04	1.05E-04	9.19E-05	6.24E-05
Invertebrate Omnivore (TL-II)	1.72E-02	1.69E-02	1.68E-02	1.68E-02	1.67E-02	1.67E-02
Invertebrate Forager (TL-III)	3.67E-02	3.62E-02	3.61E-02	3.60E-02	3.59E-02	3.57E-02
Vertebrate Forager (TL-III)	6.66E-02	6.55E-02	6.51E-02	6.49E-02	6.47E-02	6.44E-02
Predator (TL-IV)	1.15E-01	1.13E-01	1.12E-01	1.12E-01	1.11E-01	1.11E-01
Benthic Community						
Infaunal invert. (TL-II)	8.62E-05	5.48E-05	4.28E-05	3.62E-05	3.18E-05	2.16E-05
Epifaunal invert. (TL-II)	2.37E-04	1.51E-04	1.18E-04	9.94E-05	8.74E-05	5.94E-05
Forager (TL-III)	5.42E-04	3.45E-04	2.69E-04	2.28E-04	2.00E-04	1.36E-04
Predator (TL-IV)	1.86E-03	1.18E-03	9.26E-04	7.82E-04	6.88E-04	4.67E-04
Air concentration (g/m3)	5.26E-17	6.68E-17	7.83E-17	8.81E-17	9.68E-17	1.31E-16
Upper Water Column						
Fugacity (Pa)						
Water concentration (mg/L)	1.13E-12	1.02E-12	9.72E-13	9.48E-13	9.32E-13	8.95E-13
Suspended solids concentration (mg/kg)	1.48E-08	1.33E-08	1.27E-08	1.24E-08	1.22E-08	1.17E-08
Dissolved organic carbon (mg/kg)	1.98E-07	1.78E-07	1.70E-07	1.66E-07	1.63E-07	1.57E-07
Bulk Upper Water Col (mg/L)	2.67E-10	2.40E-10	2.30E-10	2.24E-10	2.21E-10	2.12E-10
Lower Water Column						
Fugacity (Pa)						
Water concentration (mg/L)	6.90E-09	4.39E-09	3.43E-09	2.89E-09	2.55E-09	1.73E-09
Suspended solids concentration (mg/kg)	1.70E-04	1.08E-04	8.43E-05	7.12E-05	6.27E-05	4.25E-05
Dissolved organic carbon (mg/kg)	1.55E-03	9.88E-04	7.72E-04	6.52E-04	5.74E-04	3.90E-04
Bulk Lower Water Col (mg/L)	2.64E-06	1.68E-06	1.31E-06	1.11E-06	9.73E-07	6.61E-07
Inside the Vessel						
Fugacity (Pa)						
Water concentration (mg/L)	1.80E-06	1.80E-06	1.80E-06	1.80E-06	1.80E-06	1.80E-06
Suspended solids concentration (mg/kg)	4.44E-02	4.44E-02	4.44E-02	4.44E-02	4.44E-02	4.44E-02
Dissolved organic carbon (mg/kg)	4.06E-01	4.06E-01	4.06E-01	4.06E-01	4.06E-01	4.06E-01
Bulk Water Inside Vessel (mg/L)	6.89E-04	6.89E-04	6.89E-04	6.89E-04	6.89E-04	6.89E-04
Sediment Bed						
Fugacity (Pa)						
Pore Water concentration (mg/L)	6.90E-09	4.39E-09	3.43E-09	2.89E-09	2.55E-09	1.73E-09
Sediment concentration (mg/kg)	1.13E-05	7.19E-06	5.62E-06	4.75E-06	4.18E-06	2.84E-06

Appendix C. Tissue Concentrations and Hazard Quotients Calculated for Short-term and Long-term Ecological Risks

C.1 Total PCB Tissue Concentrations for Communities Within 15m of the Hull

C.2 Total PCB Tissue Concentrations for Communities Within 45 m of the Hull

C.3 Total PCB Tissue Concentrations for Communities Within 60 m of the Hull

C.4 Hazard Quotients of Total PCB for Communities Within 15m of the Hull

Day 1

Day 7

Day 14

Day 28

Day 180

Day 365

Day 730

Steady State (ZOI=1)

C.5 TEQ Tissue Concentrations and Hazard Quotients of TEQs for Communities Within 15m of the Hull

Mammalian TECs and TEQs

Avian TECs and TEQs

Fish Egg TECs and TEQs

Days Since Sinking	1		
	Water Benchmarks		
	WQC-Chronic	GLWLC-Tier1	GLWLC
mg/L	0.00003	7.40E-05	1.40E-04
	Hazard Quotients (HQ)		
Upper Water Column	0.0000001	0.0000001	0.0000000
Lower Water Column	0.0207356	0.0084063	0.0044433
Inside the Vessel	16.1414750	6.5438412	3.4588875
Sediment Pore Water	0.0000892	0.0000362	0.0000191

	Sediment Benchmarks	
	TEL	PEL
mg/Kg	0.0216000	0.1890000
	Hazard Quotients (HQ)	
Bulk sediment	0.0539845	0.0218856

	Tissue Residue Benchmarks						
	TSV	Bcv-Invert	Bcv-Fish	Invert-NOED	Invert-LOED	Fish-NOED	Fish-LOED
mg/Kg wet	0.4368	0.9360	7.4463	0.6000	1.1000	1.5000	1.8000
Pelagic Community	Hazard Quotients (HQ)						
Phytoplankton (TL1)	0.0000000	0.0000000		0.0000000	0.0000000		
Zooplankton (TL-II)	0.0001132	0.0000528		0.0000824	0.0000449		
Planktivore (TL-III) Herring	0.0005412		0.0000317			0.0001576	0.0001313
Piscivore (TL-IV) Jack	0.0006933		0.0000407			0.0002019	0.0001682
Reef / Vessel Community							
Attached Algae	0.0000101	0.0000047		0.0000074	0.0000040		
Sessile filter feeder (TL-II) Bivalv	0.0002374	0.0001108		0.0001728	0.0000943		
Invertibrate Omnivore (TL-II) Urcl	0.0484856	0.0226266		0.0352976	0.0192532		
Invertibrate Forager (TL-III) Crab	0.0428151	0.0199804		0.0311694	0.0170015		
Vertibrate Forager (TL-III) Trigge	0.0332622		0.0019512			0.0096859	0.0080716
Predator (TL-IV) Grouper	0.0309351		0.0018147			0.0090083	0.0075069
Benthic Community							
Infaunal invert. (TL-II)	0.0000826	0.0000385		0.0000601	0.0000328		
Epifaunal invert. (TL-II)	0.0002299	0.0001073		0.0001673	0.0000913		
Forager (TL-III) Lobster	0.0005246	0.0002448		0.0003819	0.0002083		
Predator (TL-IV) Flounder	0.0016536		0.0000970			0.0004815	0.0004013

Days Since Sinking 1

mg/L

Upper Water Column
Lower Water Column
Inside the Vessel
Sediment Pore Water

Hazard Quotients

mg/Kg

Bulk sediment

Benchmark

	Dolphin-NOAEl	Dolphin-LOAEL	Cormor-NOAEl	Cormor-LOAEL	Gull-NOAEL	Gull-LOAEL	Turtle-NOAEL
mg/Kg wet	0.3166	1.5828	0.8000	8.0000	0.8333	8.3333	2.1788
Pelagic Community							
Phytoplankton (TL1)							
Zooplankton (TL-II)							
Planktivore (TL-III) Herring	0.0007468	0.0001494	0.0002955	0.0000296	0.0002837	0.0000284	
Piscivore (TL-IV) Jack	0.0009566	0.0001913	0.0003785	0.0000379	0.0003634	0.0000363	
Reef / Vessel Community							
Attached Algae							
Sessile filter feeder (TL-II) Bivalv	0.0003276	0.0000655			0.0001244	0.0000124	0.0000476
Invertibrate Omnivore (TL-II) Urcl	0.0669041	0.0133808			0.0254142	0.0025414	0.0097203
Invertibrate Forager (TL-III) Crab	0.0590795	0.0118159			0.0224420	0.0022442	0.0085835
Vertibrate Forager (TL-III) Trigge	0.0458976	0.0091795	0.0181612	0.0018161	0.0174347	0.0017435	
Predator (TL-IV) Grouper	0.0426865	0.0085373	0.0168906	0.0016891	0.0162149	0.0016215	
Benthic Community							
Infaunal invert. (TL-II)					0.0000433	0.0000043	0.0000166
Epifaunal invert. (TL-II)	0.0003172	0.0000634			0.0001205	0.0000120	0.0000461
Forager (TL-III) Lobster	0.0007239	0.0001448			0.0002750	0.0000275	0.0001052
Predator (TL-IV) Flounder	0.0022817	0.0004563	0.0009028	0.0000903	0.0008667	0.0000867	

Days Since Sinking	1

mg/L	
Upper Water Column	
Lower Water Column	
Inside the Vessel	
Sediment Pore Water	

mg/Kg	
Bulk sediment	

	Turtle-LOAEL	Shark-NOAEL	Shark-LOAEL
mg/Kg wet	10.8939	2.5196	4.0658
Pelagic Community			
Phytoplankton (TL1)			
Zooplankton (TL-II)			
Planktivore (TL-III) Herring		0.0000938	0.0000581
Piscivore (TL-IV) Jack		0.0001202	0.0000745
Reef / Vessel Community			
Attached Algae			
Sessile filter feeder (TL-II) Bivalv	0.0000095		
Invertibrate Omnivore (TL-II) Urcl	0.0019441		
Invertibrate Forager (TL-III) Crab	0.0017167		
Vertibrate Forager (TL-III) Trigge		0.0057663	0.0035735
Predator (TL-IV) Grouper		0.0053628	0.0033234
Benthic Community			
Infaunal invert. (TL-II)	0.0000033		
Epifaunal invert. (TL-II)	0.0000092		
Forager (TL-III) Lobster	0.0000210		
Predator (TL-IV) Flounder		0.0002867	0.0001776

Days Since Sinking 7

Water Benchmarks	WQC-Chronic	GLWLC-Tier1	GLWLC
mg/L	0.00003	7.40E-05	1.40E-04
	Hazard Quotients (HQ)		
Upper Water Column	0.0000002	0.0000001	3.70E-08
Lower Water Column	0.0209016	0.0084736	0.0044789
Inside the Vessel	16.2590946	6.5915249	3.4840917
Sediment Pore Water	0.0001045	0.0000424	0.0000224

Sediment Benchmarks	TEL	PEL
mg/Kg	0.0216000	0.1890000
	Hazard Quotients (HQ)	
Bulk sediment	0.0797240	0.0323206

	Tissue Residue Benchmarks						
7	TSV	Bcv-Invert	Bcv-Fish	Invert-NOED	Invert-LOED	Fish-NOED	Fish-LOED
mg/Kg wet	0.4368	0.9360	7.4463	0.6000	1.1000	1.5000	1.8000
Pelagic Community	Hazard Quotients (HQ)						
Phytoplankton (TL1)	0.0000000	0.0000000		0.0000000	0.0000000		
Zooplankton (TL-II)	0.0001317	0.0000614		0.0000958	0.0000523		
Planktivore (TL-III) Herring	0.0006268		0.0000368			0.0001825	0.0001521
Piscivore (TL-IV) Jack	0.0007825		0.0000459			0.0002279	0.0001899
Reef / Vessel Community							
Attached Algae	0.0000118	0.0000055		0.0000086	0.0000047		
Sessile filter feeder (TL-II) Bivalve	0.0002777	0.0001296		0.0002022	0.0001103		
Invertibrate Omnivore (TL-II) Urchin	0.0568812	0.0265445		0.0414095	0.0225870		
Invertibrate Forager (TL-III) Crab	0.0570099	0.0266046		0.0415032	0.0226381		
Vertibrate Forager (TL-III) Triggerfish	0.0388250		0.0022775			0.0113058	0.0094215
Predator (TL-IV) Grouper	0.0359396		0.0021082			0.0104656	0.0087213
Benthic Community							
Infaunal invert. (TL-II)	0.0000967	0.0000451		0.0000704	0.0000384		
Epifaunal invert. (TL-II)	0.0002688	0.0001255		0.0001957	0.0001068		
Forager (TL-III) Lobster	0.0006139	0.0002865		0.0004469	0.0002438		
Predator (TL-IV) Flounder	0.0019318		0.0001133			0.0005625	0.0004688

Days Since Sinking	7

Water Benchmarks

mg/L
Upper Water Column
Lower Water Column
Inside the Vessel
Sediment Pore Water

Sediment Benchmarks

mg/Kg	
Bulk sediment	Hazard Quotients Benchmark

7	Dolphin-NOAEl	Dolphin-LOAEL	Cormor-NOAEl	Cormor-LOAEL	Gull-NOAEL	Gull-LOAEL	Turtle-NOAEL
mg/Kg wet	0.3166	1.5828	0.8000	8.0000	0.8333	8.3333	2.1788
Pelagic Community							
Phytoplankton (TL1)							
Zooplankton (TL-II)							
Planktivore (TL-III) Herring	0.0008649	0.0001730	0.0003422	0.0000342	0.0003285	0.0000329	
Piscivore (TL-IV) Jack	0.0010797	0.0002159	0.0004272	0.0000427	0.0004102	0.0000410	
Reef / Vessel Community							
Attached Algae							
Sessile filter feeder (TL-II) Bivalve	0.0003832	0.0000766			0.0001456	0.0000146	0.0000557
Invertibrate Omnivore (TL-II) Urchin	0.0784888	0.0156978			0.0298148	0.0029815	0.0114034
Invertibrate Forager (TL-III) Crab	0.0786665	0.0157333			0.0298823	0.0029882	0.0114293
Vertibrate Forager (TL-III) Triggerfish	0.0535736	0.0107147	0.0211984	0.0021198	0.0203505	0.0020351	
Predator (TL-IV) Grouper	0.0495921	0.0099184	0.0196230	0.0019623	0.0188381	0.0018838	
Benthic Community							
Infaunal invert. (TL-II)					0.0000507	0.0000051	0.0000194
Epifaunal invert. (TL-II)	0.0003710	0.0000742			0.0001409	0.0000141	0.0000539
Forager (TL-III) Lobster	0.0008471	0.0001694			0.0003218	0.0000322	0.0001231
Predator (TL-IV) Flounder	0.0026656	0.0005331	0.0010548	0.0001055	0.0010126	0.0001013	

Days Since Sinking	7

Water Benchmarks

mg/L
Upper Water Column
Lower Water Column
Inside the Vessel
Sediment Pore Water

Sediment Benchmarks

mg/Kg
Bulk sediment

7	Turtle-LOAEL	Shark-NOAEL	Shark-LOAEL
mg/Kg wet	10.8939	2.5196	4.0658
Pelagic Community			
Phytoplankton (TL1)			
Zooplankton (TL-II)			
Planktivore (TL-III) Herring		0.0001087	0.0000673
Piscivore (TL-IV) Jack		0.0001357	0.0000841
Reef / Vessel Community			
Attached Algae			
Sessile filter feeder (TL-II) Bivalve	0.0000111		
Invertibrate Omnivore (TL-II) Urchin	0.0022807		
Invertibrate Forager (TL-III) Crab	0.0022859		
Vertibrate Forager (TL-III) Triggerfish		0.0067306	0.0041711
Predator (TL-IV) Grouper		0.0062304	0.0038611
Benthic Community			
Infaunal invert. (TL-II)	0.0000039		
Epifaunal invert. (TL-II)	0.0000108		
Forager (TL-III) Lobster	0.0000246		
Predator (TL-IV) Flounder		0.0003349	0.0002075

Days Since Sinking	14		
	Water Benchmarks		
	WQC-Chronic	GLWLC-Tier1	GLWLC
mg/L	0.00003	7.40E-05	1.40E-04
	Hazard Quotients (HQ)		
Upper Water Column	0.0000002	0.0000001	4.64E-08
Lower Water Column	0.0265914	0.0107803	0.0056982
Inside the Vessel	20.6846491	8.3856686	4.4324248
Sediment Pore Water	0.0001342	0.0000544	0.0000288

	Sediment Benchmarks	
	TEL	PEL
mg/Kg	0.0216000	0.1890000
	Hazard Quotients (HQ)	
Bulk sediment	0.1021526	0.0414132

	Tissue Residue Benchmarks						
14	TSV	Bcv-Invert	Bcv-Fish	Invert-NOED	Invert-LOED	Fish-NOED	Fish-LOED
mg/Kg wet	0.4368	0.9360	7.4463	0.6000	1.1000	1.5000	1.8000
Pelagic Community	Hazard Quotients (HQ)						
Phytoplankton (TL1)	0.0000000	0.0000000		0.0000000	0.0000000		
Zooplankton (TL-II)	0.0001662	0.0000776		0.0001210	0.0000660		
Planktivore (TL-III) Herring	0.0008549		0.0000501			0.0002489	0.0002075
Piscivore (TL-IV) Jack	0.0011111		0.0000652			0.0003235	0.0002696
Reef / Vessel Community							
Attached Algae	0.0000152	0.0000071		0.0000111	0.0000060		
Sessile filter feeder (TL-II) E	0.0003503	0.0001635		0.0002550	0.0001391		
Invertibrate Omnivore (TL-II	0.0771842	0.0360193		0.0561901	0.0306491		
Invertibrate Forager (TL-III)	0.0859509	0.0401104		0.0625723	0.0341303		
Vertibrate Forager (TL-III) T	0.0542344		0.0031814			0.0157931	0.0131609
Predator (TL-IV) Grouper	0.0509540		0.0029890			0.0148378	0.0123648
Benthic Community							
Infaunal invert. (TL-II)	0.0001230	0.0000574		0.0000895	0.0000488		
Epifaunal invert. (TL-II)	0.0003489	0.0001628		0.0002540	0.0001385		
Forager (TL-III) Lobster	0.0008270	0.0003859		0.0006021	0.0003284		
Predator (TL-IV) Flounder	0.0027387		0.0001607			0.0007975	0.0006646

Days Since Sinking 14

mg/L

Upper Water Column
Lower Water Column
Inside the Vessel
Sediment Pore Water

mg/Kg

Bulk sediment	Hazard Quotients Benchmark

14	Dolphin-NOAEl	Dolphin-LOAEL	Cormor-NOAEl	Cormor-LOAEL	Gull-NOAEL	Gull-LOAEL	Turtle-NOAEL
mg/Kg wet	0.3166	1.5828	0.8000	8.0000	0.8333	8.3333	2.1788
Pelagic Community							
Phytoplankton (TL1)							
Zooplankton (TL-II)							
Planktivore (TL-III) Herring	0.0011796	0.0002359	0.0004668	0.0000467	0.0004481	0.0000448	
Piscivore (TL-IV) Jack	0.0015331	0.0003066	0.0006066	0.0000607	0.0005824	0.0000582	
Reef / Vessel Community							
Attached Algae							
Sessile filter feeder (TL-II) E	0.0004834	0.0000967			0.0001836	0.0000184	0.0000702
Invertibrate Omnivore (TL-II	0.1065045	0.0213009			0.0404569	0.0040457	0.0154738
Invertibrate Forager (TL-III)	0.1186014	0.0237203			0.0450520	0.0045052	0.0172313
Vertibrate Forager (TL-III) T	0.0748367	0.0149673	0.0296120	0.0029612	0.0284275	0.0028428	
Predator (TL-IV) Grouper	0.0703101	0.0140620	0.0278209	0.0027821	0.0267080	0.0026708	
Benthic Community							
Infaunal invert. (TL-II)					0.0000645	0.0000064	0.0000247
Epifaunal invert. (TL-II)	0.0004814	0.0000963			0.0001829	0.0000183	0.0000699
Forager (TL-III) Lobster	0.0011412	0.0002282			0.0004335	0.0000433	0.0001658
Predator (TL-IV) Flounder	0.0037791	0.0007558	0.0014953	0.0001495	0.0014355	0.0001436	

Days Since Sinking	14

mg/L
Upper Water Column
Lower Water Column
Inside the Vessel
Sediment Pore Water

mg/Kg
Bulk sediment

14	Turtle-LOAEL	Shark-NOAEL	Shark-LOAEL
mg/Kg wet	10.8939	2.5196	4.0658
Pelagic Community			
Phytoplankton (TL1)			
Zooplankton (TL-II)			
Planktivore (TL-III) Herring		0.0001482	0.0000918
Piscivore (TL-IV) Jack		0.0001926	0.0001194
Reef / Vessel Community			
Attached Algae			
Sessile filter feeder (TL-II) E	0.0000140		
Invertibrate Omnivore (TL-II	0.0030948		
Invertibrate Forager (TL-III)	0.0034463		
Vertibrate Forager (TL-III) T		0.0094020	0.0058266
Predator (TL-IV) Grouper		0.0088333	0.0054741
Benthic Community			
Infaunal invert. (TL-II)	0.0000049		
Epifaunal invert. (TL-II)	0.0000140		
Forager (TL-III) Lobster	0.0000332		
Predator (TL-IV) Flounder		0.0004748	0.0002942

Days Since Sinking	28		
	Water Benchmarks		
	WQC-Chronic	GLWLC-Tier1	GLWLC
mg/L	0.00003	7.40E-05	1.40E-04
	Hazard Quotients (HQ)		
Upper Water Column	0.0000003	0.0000001	0.0000001
Lower Water Column	0.0283111	0.0114775	0.0060667
Inside the Vessel	22.0198129	8.9269512	4.7185313
Sediment Pore Water	0.0001298	0.0000526	0.0000278
	Sediment Benchmarks		
	TEL	PEL	
mg/Kg	0.0216000	0.1890000	
	Hazard Quotients (HQ)		
Bulk sediment	0.1528243	0.0619558	

	Tissue Residue Benchmarks						
28	TSV	Bcv-Invert	Bcv-Fish	Invert-NOED	Invert-LOED	Fish-NOED	Fish-LOED
mg/Kg wet	0.4368	0.9360	7.4463	0.6000	1.1000	1.5000	1.8000
Pelagic Community	Hazard Quotients						
Phytoplankton (TL1)	0.0000000	0.0000000		0.0000000	0.0000000		
Zooplankton (TL-II)	0.0001548	0.0000723		0.0001127	0.0000615		
Planktivore (TL-III) Herring	0.0008556		0.0000502			0.0002491	0.0002076
Piscivore (TL-IV) Jack	0.0012079		0.0000709			0.0003517	0.0002931
Reef / Vessel Community							
Attached Algae	0.0000147	0.0000069		0.0000107	0.0000058		
Sessile filter feeder (TL-II) E	0.0003246	0.0001515		0.0002363	0.0001289		
Invertibrate Omnivore (TL-II	0.0761159	0.0355207		0.0554124	0.0302249		
Invertibrate Forager (TL-III)	0.1041676	0.0486116		0.0758340	0.0413640		
Vertibrate Forager (TL-III) T	0.0731544		0.0042913			0.0213026	0.0177521
Predator (TL-IV) Grouper	0.0542258		0.0031809			0.0157906	0.0131588
Benthic Community							
Infaunal invert. (TL-II)	0.0001148	0.0000536		0.0000835	0.0000456		
Epifaunal invert. (TL-II)	0.0003303	0.0001541		0.0002404	0.0001311		
Forager (TL-III) Lobster	0.0008109	0.0003784		0.0005903	0.0003220		
Predator (TL-IV) Flounder	0.0028694		0.0001683			0.0008356	0.0006963

Days Since Sinking 28

mg/L

Upper Water Column
Lower Water Column
Inside the Vessel
Sediment Pore Water

mg/Kg

Bulk sediment

28	Dolphin-NOAEl	Dolphin-LOAEL	Cormor-NOAEl	Cormor-LOAEL	Gull-NOAEL	Gull-LOAEL	Turtle-NOAEL
mg/Kg wet	0.3166	1.5828	0.8000	8.0000	0.8333	8.3333	2.1788
Pelagic Community							
Phytoplankton (TL1)							
Zooplankton (TL-II)							
Planktivore (TL-III) Herring	0.0011806	0.0002361	0.0004672	0.0000467	0.0004485	0.0000448	
Piscivore (TL-IV) Jack	0.0016667	0.0003333	0.0006595	0.0000659	0.0006331	0.0000633	
Reef / Vessel Community							
Attached Algae							
Sessile filter feeder (TL-II) E	0.0004479	0.0000896			0.0001701	0.0000170	0.0000651
Invertibrate Omnivore (TL-II	0.1050303	0.0210061			0.0398969	0.0039897	0.0152596
Invertibrate Forager (TL-III)	0.1437382	0.0287476			0.0546005	0.0054601	0.0208834
Vertibrate Forager (TL-III) T	0.1009439	0.0201888	0.0399423	0.0039942	0.0383446	0.0038345	
Predator (TL-IV) Grouper	0.0748248	0.0149650	0.0296073	0.0029607	0.0284230	0.0028423	
Benthic Community							
Infaunal invert. (TL-II)					0.0000602	0.0000060	0.0000230
Epifaunal invert. (TL-II)	0.0004557	0.0000911			0.0001731	0.0000173	0.0000662
Forager (TL-III) Lobster	0.0011189	0.0002238			0.0004250	0.0000425	0.0001626
Predator (TL-IV) Flounder	0.0039594	0.0007919	0.0015667	0.0001567	0.0015040	0.0001504	

Days Since Sinking	28

mg/L
Upper Water Column
Lower Water Column
Inside the Vessel
Sediment Pore Water

mg/Kg
Bulk sediment

28	Turtle-LOAEL	Shark-NOAEL	Shark-LOAEL
mg/Kg wet	10.8939	2.5196	4.0658
Pelagic Community			
Phytoplankton (TL1)			
Zooplankton (TL-II)			
Planktivore (TL-III) Herring		0.0001483	0.0000919
Piscivore (TL-IV) Jack		0.0002094	0.0001298
Reef / Vessel Community			
Attached Algae			
Sessile filter feeder (TL-II) E	0.0000130		
Invertibrate Omnivore (TL-II	0.0030519		
Invertibrate Forager (TL-III)	0.0041767		
Vertibrate Forager (TL-III) T		0.0126819	0.0078592
Predator (TL-IV) Grouper		0.0094005	0.0058256
Benthic Community			
Infaunal invert. (TL-II)	0.0000046		
Epifaunal invert. (TL-II)	0.0000132		
Forager (TL-III) Lobster	0.0000325		
Predator (TL-IV) Flounder		0.0004974	0.0003083

Days Since Sinking	180		
	Water Benchmarks		
	WQC-Chronic	GLWLC-Tier1	GLWLC
mg/L	0.00003	7.40E-05	1.40E-04
	Hazard Quotients (HQ)		
Upper Water Column	0.0000003	0.0000001	0.0000001
Lower Water Column	0.0288917	0.0117128	0.0061911
Inside the Vessel	22.4709916	9.1098615	4.8152125
Sediment Pore Water	0.0001054	0.0000427	0.0000226
	Sediment Benchmarks		
	TEL	PEL	
mg/Kg	0.0216000	0.1890000	
	Hazard Quotients (HQ)		
Bulk sediment	0.1595598	0.0646864	

	Tissue Residue Benchmarks						
180	TSV	Bcv-Invert	Bcv-Fish	Invert-NOED	Invert-LOED	Fish-NOED	Fish-LOED
mg/Kg wet	0.4368	0.9360	7.4463	0.6000	1.1000	1.5000	1.8000
Pelagic Community	Hazard Quotients (HQ)						
Phytoplankton (TL1)	0.0000000	0.0000000		0.0000000	0.0000000		
Zooplankton (TL-II)	0.0001221	0.0000570		0.0000889	0.0000485		
Planktivore (TL-III) Herring	0.0007137		0.0000419			0.0002078	0.0001732
Piscivore (TL-IV) Jack	0.0011018		0.0000646			0.0003208	0.0002674
Reef / Vessel Community							
Attached Algae	0.0000119	0.0000056		0.0000087	0.0000047		
Sessile filter feeder (TL-II) E	0.0002529	0.0001180		0.0001841	0.0001004		
Invertibrate Omnivore (TL-II	0.0618117	0.0288454		0.0449989	0.0245449		
Invertibrate Forager (TL-III)	0.1017598	0.0474879		0.0740812	0.0404079		
Vertibrate Forager (TL-III) T	0.1299843		0.0076249			0.0378514	0.0315429
Predator (TL-IV) Grouper	0.1108650		0.0065034			0.0322839	0.0269032
Benthic Community							
Infaunal invert. (TL-II)	0.0000898	0.0000419		0.0000654	0.0000357		
Epifaunal invert. (TL-II)	0.0002610	0.0001218		0.0001900	0.0001036		
Forager (TL-III) Lobster	0.0006577	0.0003069		0.0004788	0.0002612		
Predator (TL-IV) Flounder	0.0024628		0.0001445			0.0007172	0.0005976

Days Since Sinking 180

mg/L

Upper Water Column
Lower Water Column
Inside the Vessel
Sediment Pore Water

mg/Kg

Bulk sediment

Hazard Quotients
Benchmark

180	Dolphin-NOAEl	Dolphin-LOAEL	Cormor-NOAEl	Cormor-LOAEL	Gull-NOAEL	Gull-LOAEL	Turtle-NOAEL
mg/Kg wet	0.3166	1.5828	0.8000	8.0000	0.8333	8.3333	2.1788
Pelagic Community							
Phytoplankton (TL1)							
Zooplankton (TL-II)							
Planktivore (TL-III) Herring	0.0009848	0.0001970	0.0003897	0.0000390	0.0003741	0.0000374	
Piscivore (TL-IV) Jack	0.0015203	0.0003041	0.0006016	0.0000602	0.0005775	0.0000578	
Reef / Vessel Community							
Attached Algae							
Sessile filter feeder (TL-II) E	0.0003490	0.0000698			0.0001326	0.0000133	0.0000507
Invertibrate Omnivore (TL-II	0.0852923	0.0170585			0.0323992	0.0032399	0.0123919
Invertibrate Forager (TL-III)	0.1404158	0.0280832			0.0533384	0.0053338	0.0204006
Vertibrate Forager (TL-III) T	0.1793620	0.0358724	0.0709714	0.0070971	0.0681326	0.0068133	
Predator (TL-IV) Grouper	0.1529798	0.0305960	0.0605323	0.0060532	0.0581110	0.0058111	
Benthic Community							
Infaunal invert. (TL-II)					0.0000471	0.0000047	0.0000180
Epifaunal invert. (TL-II)	0.0003601	0.0000720			0.0001368	0.0000137	0.0000523
Forager (TL-III) Lobster	0.0009076	0.0001815			0.0003447	0.0000345	0.0001319
Predator (TL-IV) Flounder	0.0033983	0.0006797	0.0013447	0.0001345	0.0012909	0.0001291	

Days Since Sinking	180

mg/L
Upper Water Column
Lower Water Column
Inside the Vessel
Sediment Pore Water

mg/Kg
Bulk sediment

180	Turtle-LOAEL	Shark-NOAEL	Shark-LOAEL
mg/Kg wet	10.8939	2.5196	4.0658
Pelagic Community			
Phytoplankton (TL1)			
Zooplankton (TL-II)			
Planktivore (TL-III) Herring		0.0001237	0.0000767
Piscivore (TL-IV) Jack		0.0001910	0.0001184
Reef / Vessel Community			
Attached Algae			
Sessile filter feeder (TL-II) E	0.0000101		
Invertibrate Omnivore (TL-II	0.0024784		
Invertibrate Forager (TL-III)	0.0040801		
Vertibrate Forager (TL-III) T		0.0225338	0.0139646
Predator (TL-IV) Grouper		0.0192193	0.0119106
Benthic Community			
Infaunal invert. (TL-II)	0.0000036		
Epifaunal invert. (TL-II)	0.0000105		
Forager (TL-III) Lobster	0.0000264		
Predator (TL-IV) Flounder		0.0004269	0.0002646

Days Since Sinking	365		
	Water Benchmarks		
	WQC-Chronic	GLWLC-Tier1	GLWLC
mg/L	0.00003	7.40E-05	1.40E-04
	Hazard Quotients (HQ)		
Upper Water Column	0.0000001	0.0000000	0.0000000
Lower Water Column	0.0110950	0.0044980	0.0023775
Inside the Vessel	8.6408607	3.5030516	1.8516130
Sediment Pore Water	0.0000453	0.0000184	0.0000097

	Sediment Benchmarks	
	TEL	PEL
mg/Kg	0.0216000	0.1890000
	Hazard Quotients (HQ)	
Bulk sediment	0.1312531	0.0532107

	Tissue Residue Benchmarks						
365	TSV	Bcv-Invert	Bcv-Fish	Invert-NOED	Invert-LOED	Fish-NOED	Fish-LOED
mg/Kg wet	0.4368	0.9360	7.4463	0.6000	1.1000	1.5000	1.8000
Pelagic Community	Hazard Quotients (HQ)						
Phytoplankton (TL1)	0.0000000	0.0000000		0.0000000	0.0000000		
Zooplankton (TL-II)	0.0000537	0.0000251		0.0000391	0.0000213		
Planktivore (TL-III) Herring	0.0003026		0.0000177			0.0000881	0.0000734
Piscivore (TL-IV) Jack	0.0004418		0.0000259			0.0001286	0.0001072
Reef / Vessel Community							
Attached Algae	0.0000051	0.0000024		0.0000037	0.0000020		
Sessile filter feeder (TL-II) E	0.0001120	0.0000523		0.0000815	0.0000445		
Invertibrate Omnivore (TL-II	0.0266238	0.0124244		0.0193821	0.0105721		
Invertibrate Forager (TL-III)	0.0504933	0.0235635		0.0367591	0.0200504		
Vertibrate Forager (TL-III) T	0.0695140		0.0040777			0.0202425	0.0168687
Predator (TL-IV) Grouper	0.0806254		0.0047295			0.0234781	0.0195651
Benthic Community							
Infaunal invert. (TL-II)	0.0000399	0.0000186		0.0000291	0.0000158		
Epifaunal invert. (TL-II)	0.0001151	0.0000537		0.0000838	0.0000457		
Forager (TL-III) Lobster	0.0002847	0.0001329		0.0002073	0.0001130		
Predator (TL-IV) Flounder	0.0010275		0.0000603			0.0002992	0.0002493

Days Since Sinking	365

mg/L
Upper Water Column
Lower Water Column
Inside the Vessel
Sediment Pore Water

mg/Kg
Bulk sediment

365	Dolphin-NOAEl	Dolphin-LOAEL	Cormor-NOAEl	Cormor-LOAEL	Gull-NOAEL	Gull-LOAEL	Turtle-NOAEL
mg/Kg wet	0.3166	1.5828	0.8000	8.0000	0.8333	8.3333	2.1788
Pelagic Community							
Phytoplankton (TL1)							
Zooplankton (TL-II)							
Planktivore (TL-III) Herring	0.0004175	0.0000835	0.0001652	0.0000165	0.0001586	0.0000159	
Piscivore (TL-IV) Jack	0.0006096	0.0001219	0.0002412	0.0000241	0.0002315	0.0000232	
Reef / Vessel Community							
Attached Algae							
Sessile filter feeder (TL-II) E	0.0001545	0.0000309			0.0000587	0.0000059	0.0000225
Invertibrate Omnivore (TL-II	0.0367375	0.0073475			0.0139551	0.0013955	0.0053375
Invertibrate Forager (TL-III)	0.0696744	0.0139349			0.0264666	0.0026467	0.0101228
Vertibrate Forager (TL-III) T	0.0959206	0.0191841	0.0379547	0.0037955	0.0364365	0.0036436	
Predator (TL-IV) Grouper	0.1112529	0.0222506	0.0440215	0.0044021	0.0422606	0.0042261	
Benthic Community							
Infaunal invert. (TL-II)					0.0000209	0.0000021	0.0000080
Epifaunal invert. (TL-II)	0.0001588	0.0000318			0.0000603	0.0000060	0.0000231
Forager (TL-III) Lobster	0.0003928	0.0000786			0.0001492	0.0000149	0.0000571
Predator (TL-IV) Flounder	0.0014178	0.0002836	0.0005610	0.0000561	0.0005386	0.0000539	

Days Since Sinking	365

mg/L
Upper Water Column
Lower Water Column
Inside the Vessel
Sediment Pore Water

mg/Kg
Bulk sediment

365	Turtle-LOAEL	Shark-NOAEL	Shark-LOAEL
mg/Kg wet	10.8939	2.5196	4.0658
Pelagic Community			
Phytoplankton (TL1)			
Zooplankton (TL-II)			
Planktivore (TL-III) Herring		0.0000525	0.0000325
Piscivore (TL-IV) Jack		0.0000766	0.0000475
Reef / Vessel Community			
Attached Algae			
Sessile filter feeder (TL-II) E	0.0000045		
Invertibrate Omnivore (TL-II	0.0010675		
Invertibrate Forager (TL-III)	0.0020246		
Vertibrate Forager (TL-III) T		0.0120508	0.0074681
Predator (TL-IV) Grouper		0.0139770	0.0086618
Benthic Community			
Infaunal invert. (TL-II)	0.0000016		
Epifaunal invert. (TL-II)	0.0000046		
Forager (TL-III) Lobster	0.0000114		
Predator (TL-IV) Flounder		0.0001781	0.0001104

Days Since Sinking	730		
	Water Benchmarks		
	WQC-Chronic	GLWLC-Tier1	GLWLC
mg/L	0.00003	7.40E-05	1.40E-04
	Hazard Quotients (HQ)		
Upper Water Column	0.0000001	0.0000000	0.0000000
Lower Water Column	0.0103015	0.0041763	0.0022075
Inside the Vessel	8.0079774	3.2464773	1.7159951
Sediment Pore Water	0.0000350	0.0000142	0.0000075

	Sediment Benchmarks	
	TEL	PEL
mg/Kg	0.0216000	0.1890000
	Hazard Quotients (HQ)	
Bulk sediment	0.1250824	0.0507091

	Tissue Residue Benchmarks						
730	TSV	Bcv-Invert	Bcv-Fish	Invert-NOED	Invert-LOED	Fish-NOED	Fish-LOED
mg/Kg wet	0.4368	0.9360	7.4463	0.6000	1.1000	1.5000	1.8000
Pelagic Community	Hazard Quotients (HQ)						
Phytoplankton (TL1)	0.0000000	0.0000000		0.0000000	0.0000000		
Zooplankton (TL-II)	0.0000417	0.0000195		0.0000303	0.0000166		
Planktivore (TL-III) Herring	0.0002049		0.0000120			0.0000597	0.0000497
Piscivore (TL-IV) Jack	0.0003097		0.0000182			0.0000902	0.0000752
Reef / Vessel Community							
Attached Algae	0.0000040	0.0000018		0.0000029	0.0000016		
Sessile filter feeder (TL-II) E	0.0000863	0.0000403		0.0000628	0.0000343		
Invertibrate Omnivore (TL-II	0.0177234	0.0082709		0.0129026	0.0070378		
Invertibrate Forager (TL-III)	0.0380353	0.0177498		0.0276897	0.0151035		
Vertibrate Forager (TL-III) T	0.0690116		0.0040482			0.0200962	0.0167468
Predator (TL-IV) Grouper	0.1178728		0.0069145			0.0343246	0.0286038
Benthic Community							
Infaunal invert. (TL-II)	0.0000302	0.0000141		0.0000220	0.0000120		
Epifaunal invert. (TL-II)	0.0000832	0.0000388		0.0000606	0.0000330		
Forager (TL-III) Lobster	0.0001927	0.0000899		0.0001403	0.0000765		
Predator (TL-IV) Flounder	0.0006683		0.0000392			0.0001946	0.0001622

Days Since Sinking 730

mg/L

Upper Water Column
Lower Water Column
Inside the Vessel
Sediment Pore Water

mg/Kg

Bulk sediment	Hazard Quotients Benchmark

730	Dolphin-NOAEl	Dolphin-LOAEL	Cormor-NOAEl	Cormor-LOAEL	Gull-NOAEL	Gull-LOAEL	Turtle-NOAEL
mg/Kg wet	0.3166	1.5828	0.8000	8.0000	0.8333	8.3333	2.1788
Pelagic Community							
Phytoplankton (TL1)							
Zooplankton (TL-II)							
Planktivore (TL-III) Herring	0.0002828	0.0000566	0.0001119	0.0000112	0.0001074	0.0000107	
Piscivore (TL-IV) Jack	0.0004274	0.0000855	0.0001691	0.0000169	0.0001624	0.0000162	
Reef / Vessel Community							
Attached Algae							
Sessile filter feeder (TL-II) E	0.0001191	0.0000238			0.0000452	0.0000045	0.0000173
Invertibrate Omnivore (TL-II	0.0244560	0.0048912			0.0092899	0.0009290	0.0035531
Invertibrate Forager (TL-III)	0.0524840	0.0104968			0.0199366	0.0019937	0.0076253
Vertibrate Forager (TL-III) T	0.0952273	0.0190455	0.0376803	0.0037680	0.0361731	0.0036173	
Predator (TL-IV) Grouper	0.1626497	0.0325299	0.0643586	0.0064359	0.0617842	0.0061784	
Benthic Community							
Infaunal invert. (TL-II)					0.0000158	0.0000016	0.0000061
Epifaunal invert. (TL-II)	0.0001148	0.0000230			0.0000436	0.0000044	0.0000167
Forager (TL-III) Lobster	0.0002659	0.0000532			0.0001010	0.0000101	0.0000386
Predator (TL-IV) Flounder	0.0009221	0.0001844	0.0003649	0.0000365	0.0003503	0.0000350	

Days Since Sinking	730

mg/L
Upper Water Column
Lower Water Column
Inside the Vessel
Sediment Pore Water

mg/Kg
Bulk sediment

730	Turtle-LOAEL	Shark-NOAEL	Shark-LOAEL
mg/Kg wet	10.8939	2.5196	4.0658
Pelagic Community			
Phytoplankton (TL1)			
Zooplankton (TL-II)			
Planktivore (TL-III) Herring		0.0000355	0.0000220
Piscivore (TL-IV) Jack		0.0000537	0.0000333
Reef / Vessel Community			
Attached Algae			
Sessile filter feeder (TL-II) E	0.0000035		
Invertibrate Omnivore (TL-II	0.0007106		
Invertibrate Forager (TL-III)	0.0015251		
Vertibrate Forager (TL-III) T		0.0119637	0.0074141
Predator (TL-IV) Grouper		0.0204342	0.0126634
Benthic Community			
Infaunal invert. (TL-II)	0.0000012		
Epifaunal invert. (TL-II)	0.0000033		
Forager (TL-III) Lobster	0.0000077		
Predator (TL-IV) Flounder		0.0001158	0.0000718

Days Since Sinking	800	Steady State ZOI=1	
	Water Benchmarks		
	WQC-Chronic	GLWLC-Tier1	GLWLC
mg/L	0.00003	7.40E-05	1.40E-04
	Hazard Quotients (HQ)		
Upper Water Column	0.0000089	0.0000036	0.0000019
Lower Water Column	0.0878858	0.0356294	0.0188327
Inside the Vessel	22.9796631	9.3160796	4.9242135
Sediment Pore Water	0.0002299	0.0000932	0.0000493

	Sediment Benchmarks	
	TEL	PEL
mg/Kg	0.0216000	0.1890000
	Hazard Quotients (HQ)	
Bulk sediment	0.3771446	0.1528965

	Tissue Residue Benchmarks						
800	TSV	Bcv-Invert	Bcv-Fish	Invert-NOED	Invert-LOED	Fish-NOED	Fish-LOED
mg/Kg wet	0.4368	0.9360	7.4463	0.6000	1.1000	1.5000	1.8000
Pelagic Community	Hazard Quotients (HQ)						
Phytoplankton (TL1)	0.0000000	0.0000000		0.0000000	0.0000000		
Zooplankton (TL-II)	0.0002780	0.0001297		0.0002024	0.0001104		
Planktivore (TL-III) Herring	0.0013463		0.0000790			0.0003920	0.0003267
Piscivore (TL-IV) Jack	0.0020895		0.0001226			0.0006085	0.0005071
Reef / Vessel Community							
Attached Algae	0.0000260	0.0000121		0.0000189	0.0000103		
Sessile filter feeder (TL-II) E	0.0005701	0.0002661		0.0004150	0.0002264		
Invertibrate Omnivore (TL-II	0.0394186	0.0183953		0.0286967	0.0156528		
Invertibrate Forager (TL-III)	0.0841055	0.0392492		0.0612288	0.0333975		
Vertibrate Forager (TL-III) T	0.1524123		0.0089405			0.0443825	0.0369854
Predator (TL-IV) Grouper	0.2624909		0.0153978			0.0764373	0.0636978
Benthic Community							
Infaunal invert. (TL-II)	0.0001974	0.0000921		0.0001437	0.0000784		
Epifaunal invert. (TL-II)	0.0005422	0.0002530		0.0003947	0.0002153		
Forager (TL-III) Lobster	0.0012410	0.0005791		0.0009034	0.0004928		
Predator (TL-IV) Flounder	0.0042655		0.0002502			0.0012421	0.0010351

Days Since Sinking 800 Steady State ZOI=1

mg/L

Upper Water Column
Lower Water Column
Inside the Vessel
Sediment Pore Water

mg/Kg

Bulk sediment

Hazard Quotients
Benchmark

800	Dolphin-NOAEl	Dolphin-LOAEL	Cormor-NOAEl	Cormor-LOAEL	Gull-NOAEL	Gull-LOAEL	Turtle-NOAEL
mg/Kg wet	0.3166	1.5828	0.8000	8.0000	0.8333	8.3333	2.1788
Pelagic Community							
Phytoplankton (TL1)							
Zooplankton (TL-II)							
Planktivore (TL-III) Herring	0.0018577	0.0003715	0.0007351	0.0000735	0.0007057	0.0000706	
Piscivore (TL-IV) Jack	0.0028833	0.0005767	0.0011409	0.0001141	0.0010953	0.0001095	
Reef / Vessel Community							
Attached Algae							
Sessile filter feeder (TL-II) E	0.0007867	0.0001573			0.0002988	0.0000299	0.0001143
Invertibrate Omnivore (TL-II	0.0543927	0.0108785			0.0206616	0.0020662	0.0079026
Invertibrate Forager (TL-III)	0.1160550	0.0232110			0.0440847	0.0044085	0.0168613
Vertibrate Forager (TL-III) T	0.2103098	0.0420620	0.0832171	0.0083217	0.0798884	0.0079888	
Predator (TL-IV) Grouper	0.3622044	0.0724409	0.1433200	0.0143320	0.1375872	0.0137587	
Benthic Community							
Infaunal invert. (TL-II)					0.0001034	0.0000103	0.0000396
Epifaunal invert. (TL-II)	0.0007481	0.0001496			0.0002842	0.0000284	0.0001087
Forager (TL-III) Lobster	0.0017124	0.0003425			0.0006505	0.0000650	0.0002488
Predator (TL-IV) Flounder	0.0058858	0.0011772	0.0023290	0.0002329	0.0022358	0.0002236	

Days Since Sinking	800	Steady State ZOI=1

mg/L
Upper Water Column
Lower Water Column
Inside the Vessel
Sediment Pore Water

mg/Kg
Bulk sediment

800	Turtle-LOAEL	Shark-NOAEL	Shark-LOAEL
mg/Kg wet	10.8939	2.5196	4.0658
Pelagic Community			
Phytoplankton (TL1)			
Zooplankton (TL-II)			
Planktivore (TL-III) Herring		0.0002334	0.0001446
Piscivore (TL-IV) Jack		0.0003622	0.0002245
Reef / Vessel Community			
Attached Algae			
Sessile filter feeder (TL-II) E	0.0000229		
Invertibrate Omnivore (TL-II	0.0015805		
Invertibrate Forager (TL-III)	0.0033723		
Vertibrate Forager (TL-III) T		0.0264218	0.0163741
Predator (TL-IV) Grouper		0.0455048	0.0282002
Benthic Community			
Infaunal invert. (TL-II)	0.0000079		
Epifaunal invert. (TL-II)	0.0000217		
Forager (TL-III) Lobster	0.0000498		
Predator (TL-IV) Flounder		0.0007395	0.0004583

Appendix D. Results of Quantitative Uncertainty Analysis

D.1 Bottom Current

D.2 PCB Release Rate

D.3 Bivalve Exposure to Interior Vessel Water

The effect on PCB concentrations in biotic and abiotic media as function of varying bottom current through the ZOI.						
			Default			
bottom current meters/h	93	465	926	1858	9292	
Tissue Conc. (mg/kg-WW)	Total PCB	Total PCB	Total PCB	Total PCB	Total PCB	
Pelagic Community						
Phytoplankton (TL1)	1.62E-07	6.64E-09	1.67E-09	4.16E-10	1.66E-11	
Zooplankton (TL-II)	7.68E-04	1.54E-04	7.72E-05	3.85E-05	7.69E-06	
Planktivore (TL-III)	3.72E-03	7.45E-04	3.74E-04	1.86E-04	3.73E-05	
Piscivore (TL-IV)	5.78E-03	1.16E-03	5.80E-04	2.89E-04	5.78E-05	
Reef / Vessel Community						
Attached Algae	7.17E-05	1.44E-05	7.23E-06	3.60E-06	7.20E-07	
Sessile filter feeder (TL-II)	1.57E-03	3.15E-04	1.58E-04	7.89E-05	1.58E-05	
Invertebrate Omnivore (TL-II)	2.12E-02	1.74E-02	1.69E-02	1.67E-02	1.65E-02	
Invertebrate Forager (TL-III)	4.39E-02	3.71E-02	3.62E-02	3.58E-02	3.55E-02	
Vertebrate Forager (TL-III)	8.23E-02	6.74E-02	6.55E-02	6.46E-02	6.38E-02	
Predator (TL-IV)	1.42E-01	1.16E-01	1.13E-01	1.11E-01	1.10E-01	
Benthic Community						
Infaunal invert. (TL-II)	5.44E-04	1.09E-04	5.48E-05	2.73E-05	5.46E-06	
Epifaunal invert. (TL-II)	1.50E-03	3.00E-04	1.51E-04	7.50E-05	1.50E-05	
Forager (TL-III)	3.42E-03	6.86E-04	3.45E-04	1.72E-04	3.43E-05	
Predator (TL-IV)	1.18E-02	2.36E-03	1.18E-03	5.90E-04	1.18E-04	
Air concentration (g/m3)	1.81E-14	1.37E-16	6.68E-17	3.21E-17	5.67E-18	
Upper Water Column						
Fugacity (Pa)						
Water concentration (mg/L)	9.83E-11	4.03E-12	1.02E-12	2.52E-13	1.01E-14	
Suspended solids concentration (mg/kg)	1.29E-06	5.26E-08	1.33E-08	3.29E-09	1.32E-10	
Dissolved organic carbon (mg/kg)	1.73E-05	7.05E-07	1.78E-07	4.42E-08	1.77E-09	
Bulk Upper Water Col (mg/L)	2.33E-08	9.53E-10	2.40E-10	5.97E-11	2.39E-12	
Lower Water Column						
Fugacity (Pa)						
Water concentration (mg/L)	4.35E-08	8.73E-09	4.39E-09	2.19E-09	4.37E-10	
Suspended solids concentration (mg/kg)	1.07E-03	2.15E-04	1.08E-04	5.38E-05	1.08E-05	
Dissolved organic carbon (mg/kg)	9.80E-03	1.97E-03	9.88E-04	4.92E-04	9.85E-05	
Bulk Lower Water Col (mg/L)	1.66E-05	3.34E-06	1.68E-06	8.35E-07	1.67E-07	
Inside the Vessel						
Fugacity (Pa)						
Water concentration (mg/L)	1.80E-06	1.80E-06	1.80E-06	1.80E-06	1.80E-06	
Suspended solids concentration (mg/kg)	4.44E-02	4.44E-02	4.44E-02	4.44E-02	4.44E-02	
Dissolved organic carbon (mg/kg)	4.06E-01	4.06E-01	4.06E-01	4.06E-01	4.06E-01	
Bulk Water Inside Vessel (mg/L)	6.89E-04	6.89E-04	6.89E-04	6.89E-04	6.89E-04	
Sediment Bed						
Fugacity (Pa)						
Pore Water concentration (mg/L)	4.35E-08	8.73E-09	4.39E-09	2.19E-09	4.37E-10	
Sediment concentration (mg/kg)	7.14E-05	1.43E-05	7.19E-06	3.58E-06	7.17E-07	

The effect on PCB concentrations in biotic and abiotic media as function of varying bottom current through the ZOI.					
	% of default condition				
bottom current meters/h	10%	50%	100%	201%	1003%
Tissue Conc. (mg/kg-WW)					
Pelagic Community		factor change from default condition			
Phytoplankton (TL1)	96.747	3.964	1.000	0.248	0.010
Zooplankton (TL-II)	9.950	1.992	1.000	0.498	0.100
Planktivore (TL-III)	9.955	1.992	1.000	0.498	0.100
Piscivore (TL-IV)	9.954	1.992	1.000	0.498	0.100
Reef / Vessel Community					
Attached Algae	9.915	1.991	1.000	0.498	0.100
Sessile filter feeder (TL-II)	9.925	1.991	1.000	0.498	0.100
Invertebrate Omnivore (TL-II)	1.250	1.028	1.000	0.986	0.975
Invertebrate Forager (TL-III)	1.212	1.024	1.000	0.988	0.979
Vertebrate Forager (TL-III)	1.256	1.028	1.000	0.986	0.974
Predator (TL-IV)	1.255	1.028	1.000	0.986	0.974
Benthic Community					
Infaunal invert. (TL-II)	9.927	1.991	1.000	0.498	0.100
Epifaunal invert. (TL-II)	9.930	1.992	1.000	0.498	0.100
Forager (TL-III)	9.925	1.991	1.000	0.498	0.100
Predator (TL-IV)	9.926	1.991	1.000	0.498	0.100
Air concentration (g/m3)	270.730	2.050	1.000	0.481	0.085
Upper Water Column					
Fugacity (Pa)					
Water concentration (mg/L)	96.747	3.964	1.000	0.248	0.010
Suspended solids concentration (mg/kg)	97.248	3.965	1.000	0.248	0.010
Dissolved organic carbon (mg/kg)	97.009	3.964	1.000	0.248	0.010
Bulk Upper Water Col (mg/L)	97.140	3.964	1.000	0.248	0.010
Lower Water Column					
Fugacity (Pa)					
Water concentration (mg/L)	9.915	1.991	1.000	0.498	0.100
Suspended solids concentration (mg/kg)	9.918	1.991	1.000	0.498	0.100
Dissolved organic carbon (mg/kg)	9.916	1.991	1.000	0.498	0.100
Bulk Lower Water Col (mg/L)	9.918	1.991	1.000	0.498	0.100
Inside the Vessel					
Fugacity (Pa)					
Water concentration (mg/L)	1.000	1.000	1.000	1.000	1.000
Suspended solids concentration (mg/kg)	1.000	1.000	1.000	1.000	1.000
Dissolved organic carbon (mg/kg)	1.000	1.000	1.000	1.000	1.000
Bulk Water Inside Vessel (mg/L)	1.000	1.000	1.000	1.000	1.000
Sediment Bed					
Fugacity (Pa)					
Pore Water concentration (mg/L)	9.915	1.991	1.000	0.498	0.100
Sediment concentration (mg/kg)	9.918	1.991	1.000	0.498	0.100

The effect on PCB concentrations in biotic and abiotic media as function of varying the daily PCB release rate.						
	B. No BHI	D. 5247kg BHI	**A. PRAM Defaults 14379Kg**	E. 26000 kg BHI	F. 52478 kg BHI (original amount)	
Daily PCB Release Rate (ng/day)	2.4E+08	4.3E+08	7.62E+08	1.18E+09	2.15E+09	
Tissue Conc. (mg/kg-WW)	Total PCB	Total PCB	Total PCB	Total PCB	Total PCB	
Pelagic Community						
Phytoplankton (TL1)	5.13E-10	9.37E-10	1.67E-09	2.61E-09	4.75E-09	
Zooplankton (TL-II)	2.27E-05	4.26E-05	7.72E-05	1.21E-04	2.22E-04	
Planktivore (TL-III)	7.12E-05	1.82E-04	3.74E-04	6.19E-04	1.18E-03	
Piscivore (TL-IV)	1.40E-04	3.00E-04	5.80E-04	9.37E-04	1.75E-03	
Reef / Vessel Community						
Attached Algae	2.11E-06	3.98E-06	7.23E-06	1.14E-05	2.08E-05	
Sessile filter feeder (TL-II)	4.51E-05	8.65E-05	1.58E-04	2.50E-04	4.58E-04	
Invertebrate Omnivore (TL-II)	2.79E-03	7.96E-03	1.69E-02	2.84E-02	5.44E-02	
Invertebrate Forager (TL-III)	5.86E-03	1.69E-02	3.62E-02	6.08E-02	1.17E-01	
Vertebrate Forager (TL-III)	9.24E-03	2.98E-02	6.55E-02	1.11E-01	2.15E-01	
Predator (TL-IV)	1.88E-02	5.31E-02	1.13E-01	1.89E-01	3.62E-01	
Benthic Community						
Infaunal invert. (TL-II)	1.48E-05	2.94E-05	5.48E-05	8.72E-05	1.61E-04	
Epifaunal invert. (TL-II)	3.53E-05	7.74E-05	1.51E-04	2.44E-04	4.56E-04	
Forager (TL-III)	6.19E-05	1.65E-04	3.45E-04	5.73E-04	1.09E-03	
Predator (TL-IV)	1.79E-04	5.46E-04	1.18E-03	2.00E-03	3.85E-03	
Air concentration (g/m3)	2.23E-17	3.86E-17	6.68E-17	1.03E-16	1.85E-16	
Upper Water Column						
Fugacity (Pa)						
Water concentration (mg/L)	3.12E-13	5.69E-13	1.02E-12	1.59E-12	2.88E-12	
Suspended solids concentration (mg/kg)	3.88E-09	7.31E-09	1.33E-08	2.08E-08	3.81E-08	
Dissolved organic carbon (mg/kg)	2.62E-08	8.15E-08	1.78E-07	3.00E-07	5.80E-07	
Bulk Upper Water Col (mg/L)	5.49E-11	1.23E-10	2.40E-10	3.90E-10	7.32E-10	
Lower Water Column						
Fugacity (Pa)						
Water concentration (mg/L)	1.28E-09	2.41E-09	4.39E-09	6.90E-09	1.26E-08	
Suspended solids concentration (mg/kg)	4.86E-05	7.02E-05	1.08E-04	1.56E-04	2.65E-04	
Dissolved organic carbon (mg/kg)	2.34E-04	5.09E-04	9.88E-04	1.60E-03	2.99E-03	
Bulk Lower Water Col (mg/L)	6.28E-07	1.01E-06	1.68E-06	2.52E-06	4.46E-06	
Inside the Vessel						
Fugacity (Pa)						
Water concentration (mg/L)	5.26E-07	9.92E-07	1.80E-06	2.84E-06	5.19E-06	
Suspended solids concentration (mg/kg)	2.00E-02	2.89E-02	4.44E-02	6.41E-02	1.09E-01	
Dissolved organic carbon (mg/kg)	9.64E-02	2.09E-01	4.06E-01	6.57E-01	1.23E+00	
Bulk Water Inside Vessel (mg/L)	2.58E-04	4.16E-04	6.89E-04	1.04E-03	1.83E-03	
Sediment Bed						
Fugacity (Pa)						
Pore Water concentration (mg/L)	1.28E-09	2.41E-09	4.39E-09	6.90E-09	1.26E-08	
Sediment concentration (mg/kg)	3.24E-06	4.68E-06	7.19E-06	1.04E-05	1.77E-05	

The effect on PCB concentrations in biotic and abiotic media as function of varying the daily PCB release rate.					
		% of default condition			
Daily PCB Release Rate (ng/day)	31%	56%	100%	155%	282%
Tissue Conc. (mg/kg-WW)					
Pelagic Community		factor change from default condition			
Phytoplankton (TL1)	0.307	0.560	1.000	1.560	2.837
Zooplankton (TL-II)	0.294	0.551	1.000	1.571	2.871
Planktivore (TL-III)	0.190	0.486	1.000	1.654	3.145
Piscivore (TL-IV)	0.241	0.518	1.000	1.614	3.012
Reef / Vessel Community					
Attached Algae	0.292	0.550	1.000	1.572	2.877
Sessile filter feeder (TL-II)	0.285	0.546	1.000	1.578	2.894
Invertebrate Omnivore (TL-II)	0.165	0.470	1.000	1.675	3.213
Invertebrate Forager (TL-III)	0.162	0.468	1.000	1.678	3.221
Vertebrate Forager (TL-III)	0.141	0.454	1.000	1.694	3.276
Predator (TL-IV)	0.167	0.471	1.000	1.673	3.208
Benthic Community					
Infaunal invert. (TL-II)	0.270	0.536	1.000	1.590	2.935
Epifaunal invert. (TL-II)	0.234	0.514	1.000	1.619	3.029
Forager (TL-III)	0.180	0.479	1.000	1.663	3.174
Predator (TL-IV)	0.151	0.461	1.000	1.686	3.249
	0.141	7.090			
Air concentration (g/m3)	0.334	0.577	1.000	1.538	2.765
Upper Water Column					
Fugacity (Pa)					
Water concentration (mg/L)	0.307	0.560	1.000	1.560	2.837
Suspended solids concentration (mg/kg)	0.293	0.551	1.000	1.571	2.874
Dissolved organic carbon (mg/kg)	0.147	0.459	1.000	1.689	3.259
Bulk Upper Water Col (mg/L)	0.228	0.510	1.000	1.624	3.045
Lower Water Column					
Fugacity (Pa)					
Water concentration (mg/L)	0.292	0.550	1.000	1.572	2.877
Suspended solids concentration (mg/kg)	0.450	0.651	1.000	1.444	2.457
Dissolved organic carbon (mg/kg)	0.237	0.515	1.000	1.617	3.021
Bulk Lower Water Col (mg/L)	0.374	0.603	1.000	1.506	2.657
Inside the Vessel					
Fugacity (Pa)					
Water concentration (mg/L)	0.292	0.550	1.000	1.572	2.877
Suspended solids concentration (mg/kg)	0.450	0.651	1.000	1.444	2.457
Dissolved organic carbon (mg/kg)	0.237	0.515	1.000	1.617	3.021
Bulk Water Inside Vessel (mg/L)	0.374	0.603	1.000	1.506	2.657
	2.671				
Sediment Bed					
Fugacity (Pa)					
Pore Water concentration (mg/L)	0.292	0.550	1.000	1.572	2.877
Sediment concentration (mg/kg)	0.450	0.651	1.000	1.444	2.457

The effect on PCB concentrations in biota as function of increasing bivalve expsosure to interior vessel water.						
			A. PRAM Defaults	B. 50%	C. 100%	
Bivalve Exposure to Interior Water			0.01	0.5	0.99	
Tissue Conc. (mg/kg-WW)			Total PCB	Total PCB	Total PCB	
Pelagic Community						
Phytoplankton (TL1)			1.67E-09	1.67E-09	1.67E-09	
Zooplankton (TL-II)			7.72E-05	7.72E-05	7.72E-05	
Planktivore (TL-III)			3.74E-04	3.74E-04	3.74E-04	
Piscivore (TL-IV)			5.80E-04	5.80E-04	5.80E-04	
Reef / Vessel Community						
Attached Algae			7.23E-06	7.23E-06	7.23E-06	
Bivalve (TL-II)			1.58E-04	2.78E-02	5.49E-02	
Invertebrate Omnivore (TL-II)			1.69E-02	5.33E-02	8.89E-02	
Invertebrate Forager (TL-III)			3.62E-02	1.04E-01	1.71E-01	
Vertebrate Forager (TL-III)			6.55E-02	1.91E-01	3.15E-01	
Predator (TL-IV)			1.13E-01	3.13E-01	5.09E-01	
Benthic Community						
Infaunal invert. (TL-II)			5.48E-05	5.48E-05	5.48E-05	
Epifaunal invert. (TL-II)			1.51E-04	1.51E-04	1.51E-04	
Forager (TL-III)			3.45E-04	3.45E-04	3.45E-04	
Predator (TL-IV)			1.18E-03	1.18E-03	1.18E-03	

The effect on PCB concentrations in biota as function of increasing bivalve expsosure to interior vessel water.						
			% of default condition			
Bivalve Exposure to Interior Water			100%	5000%	9900%	
Tissue Conc. (mg/kg-WW)						
Pelagic Community						
Phytoplankton (TL1)			1.000	1.000	1.000	
Zooplankton (TL-II)			1.000	1.000	1.000	
Planktivore (TL-III)			1.000	1.000	1.000	
Piscivore (TL-IV)			1.000	1.000	1.000	
Reef / Vessel Community						
Attached Algae			1.000	1.000	1.000	
Bivalve (TL-II)			1.000	175.585	346.676	
Invertebrate Omnivore (TL-II)			1.000	3.144	5.244	
Invertebrate Forager (TL-III)			1.000	2.872	4.706	
Vertebrate Forager (TL-III)			1.000	2.923	4.807	
Predator (TL-IV)			1.000	2.775	4.514	
Benthic Community						
Infaunal invert. (TL-II)			1.000	1.000	1.000	
Epifaunal invert. (TL-II)			1.000	1.000	1.000	
Forager (TL-III)			1.000	1.000	1.000	
Predator (TL-IV)			1.000	1.000	1.000	

The effect on PCB concentrations in biota as function of increasing bivalve expsosure to interior vessel water.						
			50%			
Bivalve Exposure to Interior Water						
Tissue Conc. (mg/kg-WW)		Dolphin-N	TSV	Invert-NOED		Dolphin-N
Pelagic Community		0.316551	0.4368	0.6		0.316551
Phytoplankton (TL1)		0.000	0.000			0.000
Zooplankton (TL-II)		0.000	0.000			0.000
Planktivore (TL-III)		0.001	0.001			0.001
Piscivore (TL-IV)		0.002	0.001			0.002
Reef / Vessel Community						
Attached Algae		0.000	0.000			0.000
Bivalve (TL-II)		0.088	0.064	0.091		0.173
Invertebrate Omnivore (TL-II)		0.168	0.122			0.281
Invertebrate Forager (TL-III)		0.329	0.238			0.539
Vertebrate Forager (TL-III)		0.605	0.438			0.995
Predator (TL-IV)		0.989	0.717			1.609
Benthic Community						
Infaunal invert. (TL-II)		0.000	0.000			0.000
Epifaunal invert. (TL-II)		0.000	0.000			0.000
Forager (TL-III)		0.001	0.001			0.001
Predator (TL-IV)		0.004	0.003			0.004

The effect on PCB concentrations in biota as function of increasing bivalve expsosure to interior vessel water.						
	99%					
Bivalve Exposure to Interior Water						
Tissue Conc. (mg/kg-WW)	TSV	Invert-NOE	Cormor-N(	Gull-NOAE	Bcv-Invert	Invert-LOE
Pelagic Community	0.4368	0.6	0.8	0.833333	0.936	1.1
Phytoplankton (TL1)	0.000	0.000	0.000	0.000	0.000	
Zooplankton (TL-II)	0.000	0.000	0.000	0.000	0.000	
Planktivore (TL-III)	0.001	0.001	0.000	0.000	0.000	
Piscivore (TL-IV)	0.001	0.001	0.001	0.001	0.001	
Reef / Vessel Community						
Attached Algae	0.000	0.000	0.000	0.000	0.000	
Bivalve (TL-II)	0.126	0.091	0.069	0.066	0.059	
Invertebrate Omnivore (TL-II)	0.203	0.148	0.111	0.107	0.095	
Invertebrate Forager (TL-III)	0.390	0.284	0.213	0.205	0.182	
Vertebrate Forager (TL-III)	0.721	0.525	0.394	0.378	0.336	
Predator (TL-IV)	1.166	0.849	0.637	0.611	0.544	
Benthic Community						
Infaunal invert. (TL-II)	0.000	0.000	0.000	0.000	0.000	
Epifaunal invert. (TL-II)	0.000	0.000	0.000	0.000	0.000	
Forager (TL-III)	0.001	0.001	0.000	0.000	0.000	
Predator (TL-IV)	0.003	0.002	0.001	0.001	0.001	

Space and Naval Warfare Systems Center
Advanced Systems and Applied Sciences Division
Environmental Sciences and Applied Systems Branch
Marine Environmental Support Office
Code 2375, 53475 Strothe Rd.
San Diego, CA 92152-6326 USA
http://meso.spawar.navy.mil